Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

March, 1935

Volume 109 *No. 3*

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 55 New Montgomery St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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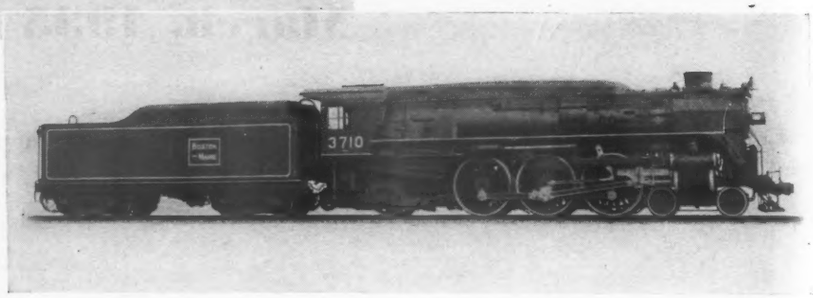

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Railway
Mechanical Engineer

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March - 1935

The Second Self-Propelled Stainless Steel Train

THE "Flying Yankee," which was delivered to the Boston & Maine on February 9, is the second 600-hp., self-propelled articulated train of lightweight stainless-steel construction to be built by the Edward G. Budd Manufacturing Company, Philadelphia, Pa.

The new train, built on an order placed by the railroad with the Winton division of General Motors Corporation, consists of three body sections carried on four trucks. It is 199 ft. 2¾ in. long, weighs 213,600 lb. when supplied with fuel, water and sand, ready to run, and is driven by a Winton 600-hp. Diesel-electric power plant. It is streamlined with smoothly curved front and rear ends and smooth longitudinal surfaces. Enclosed under-bodies give a tubular cross-section between the trucks and the latter are shrouded at the sides. Wind-tunnel tests at the Massachusetts Institute of Technology and experience with the Burlington Zephyr indicate that, at a speed of 95 m.p.h., the total resistance to motion is reduced to about 47 per cent of that of a train of three coaches of conventional shape, but of the same weight.

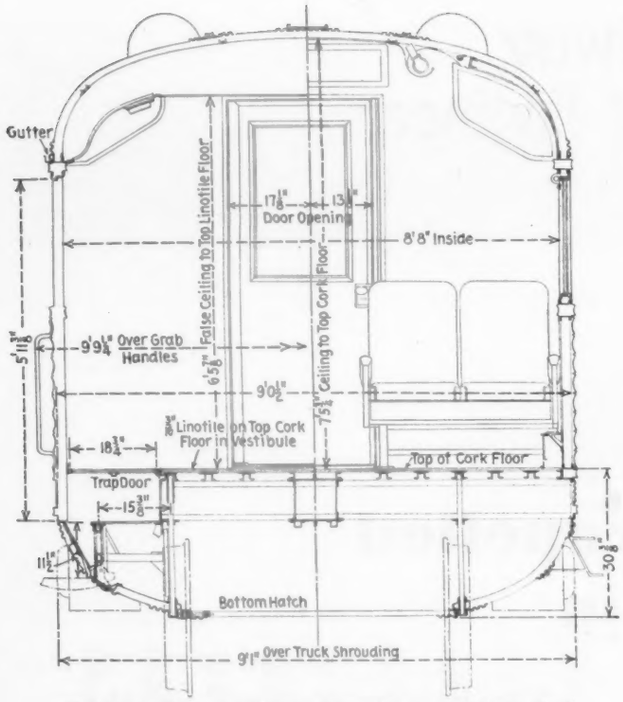
The train contains a small baggage compartment, a compact, well-designed buffet, four passenger compartments, a lounge-observation room, toilets, lockers and unusually spacious racks for the storage of hand luggage, in addition to the usual overhead parcel racks and floor space under the seats. Seats are provided for 140 persons, of which 20 are chairs in the observation lounge.

The "Flying Yankee" of the Boston & Maine was built by the Edward G. Budd Manufacturing Company. It seats 140 passengers, weighs 213,600 lb. ready for service, and is driven by a Winton 600-hp. Diesel-electric power plant

To a very large extent the entire body structure of the train from floor to roof performs load-carrying functions. The Budd form of truss construction, which employs built-up sections of thin-gage stainless steel, is used. The truss members are generally of box sections formed of deep flanged channels and cover plates. The 18-8 steel of which these sections are formed has a minimum tensile strength of 150,000 lb. per sq. in. and an elastic limit of 120,000 lb. per sq. in., with satisfactory ductility and resistance to fatigue.

All welding in the structure was done by the Shotweld process, developed and patented by the Edward G. Budd Manufacturing Company. The welds will withstand torsion up to 90 deg. They develop a shear-

The "Flying Yankee"



Typical cross-sections through a stainless-steel car body

ing strength of 75,000 lb. per sq. in.

The floor forms a stiff horizontal girder through which end loads are distributed to the side girders. Its structure is made up of a corrugated sheet of stainless steel, the bottoms of the rectangular corrugations of which are welded to a flat sheet and both in turn welded to the longitudinal stringers, of which there are ten across the car. These, in turn, are secured to transverse supports built into the car frame.

In addition to the compressive strength of the floor which, by itself, is sufficient to satisfy R.M.S. requirements for buffing conditions, there is included a center-sill designed to meet R.M.S. specifications for a 50 per cent heavier train. In the baggage compartment the floor is designed for a loading of 600 lb., per lineal foot.

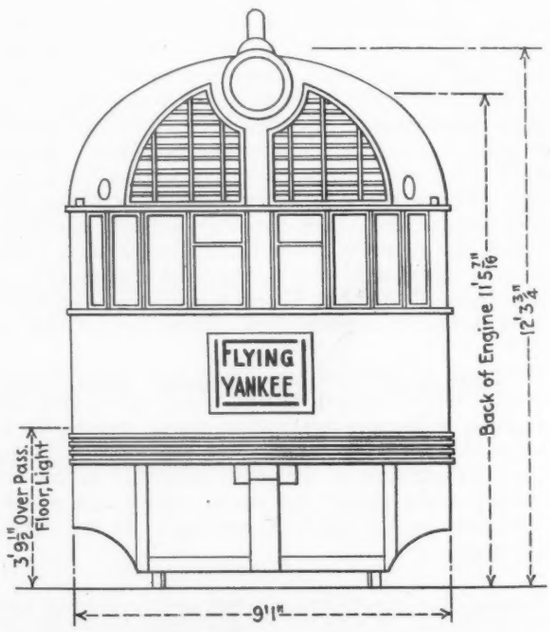
The roof is designed to assume the entire compression load. It is built up of longitudinal corrugated sheets welded to roof carlines and is locally reinforced with flat sheets, welded between the corrugated sheets and the carlines at points of maximum stress.

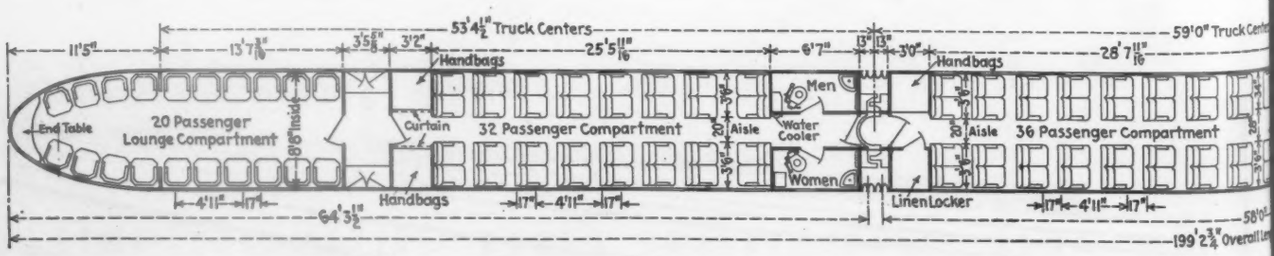
The enclosure below the floor is not a primary part of the load-carrying structure, except at the baggage doorway where it is reinforced to serve much the same purpose as the roof. Longitudinal trusses which extend from end to end of each underbody between the sides and center sills serve to add torsional stiffness to the entire structure and are reinforced at the step wells. Between them is a clear space, closed with light hatch covers, in which all piping, tanks, wiring, etc., are disposed. Because all equipment is thus accessible from the inspection pit, with one or two minor exceptions, no openings or trap doors have been provided through the floor.

The engine bed, fabricated by Lukenweld, Inc., is a rigid arc-welded structure of steel plate, annealed after completion of the welding, which weighs 6,800 lbs. It forms a combination bumper, engine bed and bolster. The material is Lukens Steel Company Cromansil, with a tensile strength of 90,000 lb. and an elastic limit of 70,000 lb., possessing a high resistance to fatigue and shock. It is built into the lower chord member of the side trusses and forms the foundation for the nose structure of the car. All vertical end members are framed into pockets in its top member.

In order to reduce the local deflections at the bolster beam of the rear truck and near the articulation castings it was necessary to limit the stresses to a rather low figure. Members similarly fabricated by Lukenweld are built into the car structure at these points. Near the articulation castings these members are combined center sills and needle beams which bring the entire side-truss structure into play to resist the bending set up in the center sills and floor structure by the eccentric center-plate loading of the articulation casting.

The nose construction consists of a deep, stiff diagonal member in the vertical center plane of the car which is reinforced with a stiff horizontal arch at the belt rail and with a diaphragm which forms the bottom of the engine-cooling air-intake chamber above the cab windows. This diaphragm consists primarily of two horizontal ⅛-in. stainless-steel plates, separated by

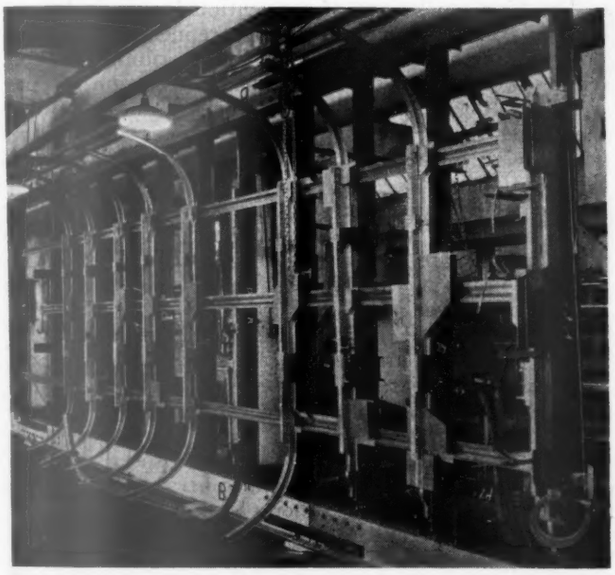




Arrangement of compartments

stiffening members, sloping back from the central collision post diagonally to the upper side rail. A tie bar across the car resists the spreading action resulting from a blow on this collision beam. This horizontal beam also serves as the top support for the intermediate posts around this end, all of which are reinforced for maximum collision protection. By placing the stiffening members between the two plates, smooth surfaces are provided both at the ceiling of the operators compartment and on the floor of the air intake chamber.

The articulation castings are tied into the bodies by riveting to the end posts and frame and also to the Cromansil reinforcements at the ends of the center sills. No rivets other than those connecting the end-sill castings, engine bed, needle beams and the rear bolster beam to the side frame are used in the car structure. The transverse horizontal arms of the castings extend out only far enough to carry the side bearings, and the load is carried to the side frames through the end truss structure. Through the stiff end structure the reaction from the weight on the truck center is carried to the main side frames. The bending moment due to



A special gig is used for fabricating the side frames

the eccentric loading at the articulation center pins is distributed to the center sill and the deep vertical end posts of ⅛-in. stainless steel.

The deadlight panels are finished with smooth surfaces. These laminated panels, some of which are of unusual length, are flexibly attached at the belt and upper moldings, sealed with plastic calking material and secured by means of bolts. They are stainless steel outside, copper inside with a wood lamination between, and are furnished by the United States Plywood Co., Inc.

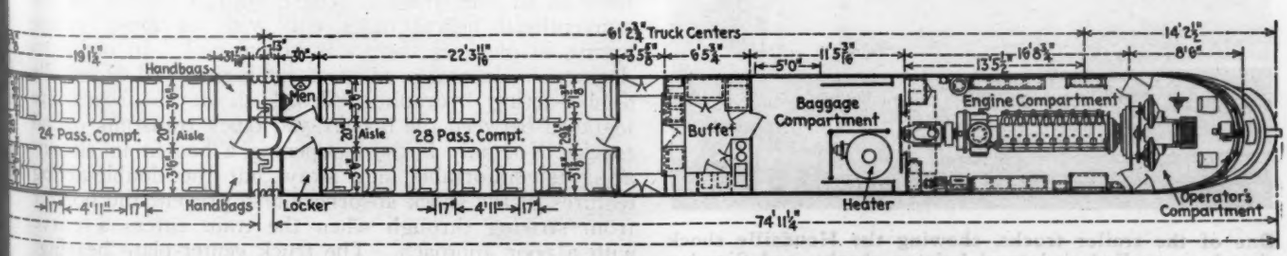
Applying the insulation

The space below the floor level is enclosed with light corrugated sheathing similar to the roofing with light hatch sections under the center. This sheathing is insulated with ½-in. hair felt stitched between two layers of 80-lb. waterproof kraft paper, the outer side of which is cemented to the sheathing, an arrangement which prevents resonance.

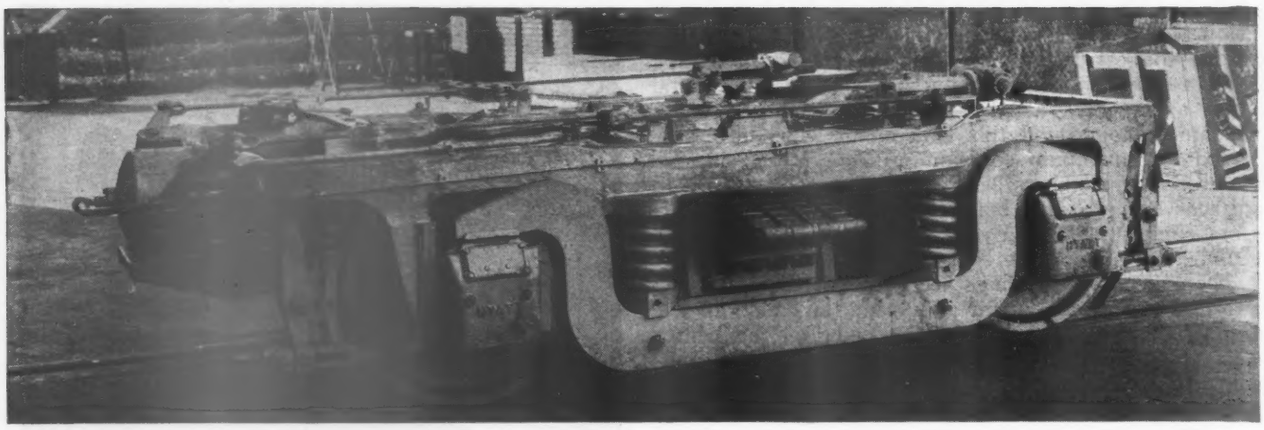
The side walls and roofs of the cars are insulated throughout with a 2-in. Dry-Zero blanket. This material is very light and combines low conductivity with added sound-deadening qualities.

In the coach compartments the side walls and headlining are finished with Masonite panels. The headlining in the lounge compartment is of molded Agasote. The walls of the baggage compartments are of corrugated galvanized sheets. The floors are laid with 5/16-in. cork tile, cemented to the corrugated steel flooring. In the baggage compartment two layers of heavy roofing paper are applied between the ⅞-in. tongue-and-groove maple and the corrugated steel flooring.

Swing type, double doors serve the passenger com-



ties in the "Flying Yankee"

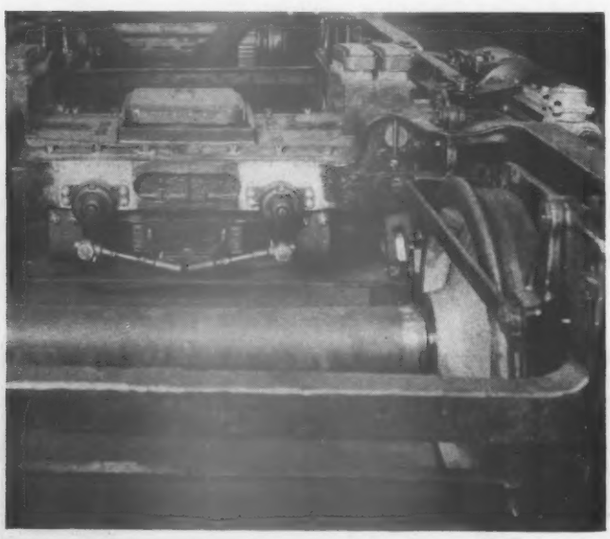


The power truck

partments at the step wells, which are closed by trap doors. The bottom step folds up when the trap is closed and, with the doors, forms an unbroken surface with the adjoining outside sheathing. Alan Wood Diamondette plates are applied on all steps as well as on the engine room floor.

Vestibule passages between the car bodies are enclosed by elastic diaphragms bolted to the ends of the cars. To provide continuity of the outer surfaces accordion type diaphragms are attached between the ends of adjoining cars.

All side windows are flush with the outside surface of the train. With the exception of the doors and the curved sash in the lounge compartment, they are glazed with double hermetically sealed units, furnished by the Pittsburgh Plate Glass Company, and are made up of two pieces of ¼-in. special Duplate shatterproof glass having ¼-in. dry air space between. These two pieces of glass are framed with a stainless-steel band to protect the edges. The special features of these hermetically sealed units is that condensation and frost will not form in the air space between the two pieces of glass. Special attention has been given to the re-glazing of the window sash, it being so designed that all this work can be performed easily from the outside of the car. The sash frames were furnished by the O. M. Edwards Co.



One of the trailer trucks, showing the Houdaille shock absorbers applied as lateral bolster checks, and Simplex Unit-cylinder clasp brake on one side of the truck

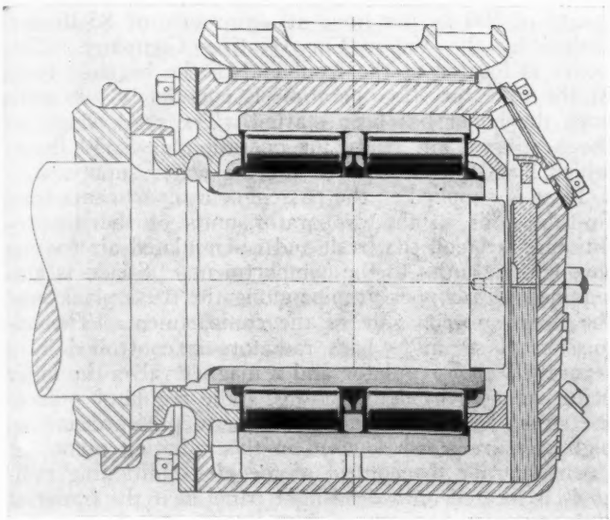
Trucks

The four trucks are of conventional outside bearing type of construction with various refinements and improvements in design to improve the riding qualities, reduce weight and render quieter operation. They weigh 54,100 lb., exclusive of the gears and motors of the power truck, and all have side frames and bolsters which were furnished by the General Steel Castings Corporation.

The power truck, carrying the weight of the power plant, has 36-in. wheels and hollow-bored axles. The trailer trucks are considerably lighter in construction and run on 30-in. wheels. All journals are fitted with Hyatt roller bearings. The bearings have solid rollers, with hardened one-piece cages and inner and outer races. The boxes are electric cast steel and all parts of the boxes and bearings can be completely and easily taken down with ordinary wrenches. The design retains the free lateral motion feature. Provision is made at the front of the box for visual inspection of lateral clearance and of the thrust members without draining the oil or disturbing other parts.

Rubber inserts are used extensively in the trucks. There are inserts under the center plate, in both top and bottom equalizer spring seats and between the ends of the equalizers and journal boxes. The bolster chafing plates are of hardened spring steel, but are insulated from the frame by vulcanized pads of sound-deadening rubber. At the sides of the center plate are strips of rubberized fabric belt material which take fore and aft thrusts and prevent metallic contact and transmission of sound. Rubber thimbles are also provided around the king pin and the center-plate bolts, the latter also including washers. Automotive brake lining is used wherever the members of the truck-brake rigging are likely to rub.

Holland helical-volute springs are used on the equalizers of all four trucks. These springs consist of the conventional helical outer coil with an inner volute spring in place of the inner helical coil. In order to dampen horizontal oscillations at high speed Houdaille double-acting hydraulic railroad shock absorbers are installed between the bolster and truck transoms on all trucks. Not only is the dampening a benefit in eliminating uncomfortable side sway, but the double-acting features of the shock absorbers also prevent the bolster from striking through when the train enters a curve with a poor approach. The truck center-plate bearing, the bearing between the two articulation castings and



Hyatt journal bearing with solid rollers

also the truck side bearings are all faced with Oilite.

The trucks are equipped with Simplex unit cylinder clasp brakes. On the power truck the brakes are operated by a single cylinder mounted on the rear end frame. Each trailer truck is equipped with two cylinders, one on each side, outside of the truck frames.

The distribution of the train weight is such that no two trucks are loaded alike. With the train ready for service the power truck is estimated to carry a weight at the rails of 94,000 lb.; the first trailer truck between the first and second car bodies, 47,700 lb.; the second trailer truck between the second and third car bodies, 42,800 lb., and the third trailer truck at the rear end of the train, 29,100 lb.

The Power Plant and Control

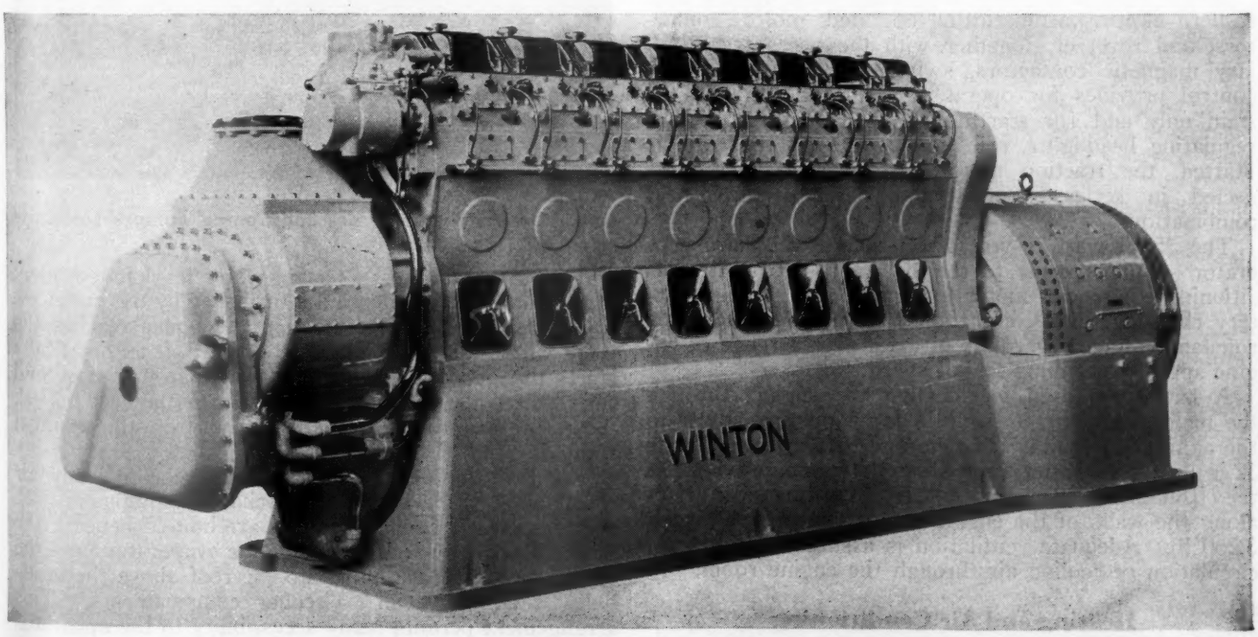
The power plant was designed by the Winton Engine Company, a division of the General Motors Corporation. The prime mover is a Winton 600-hp., high compression, two-cycle, 8-in. by 10 in., eight-in-line Diesel engine. Power for all auxiliaries is taken from the engine in excess of its 600-hp. rating at 750 r.p.m. A 75-cu.-ft.-per-min. Gardner-Denver air-compressor is driven mechanically directly from the rear end of the crank shaft of the engine. The weight of the engine is about 22 lb. per hp. which has been obtained by the use of a cylinder block built up from steel plate by arc welding. The crank shaft has nine bearings. The cylinder liners are of heat-treated, cast iron with air-intake ports encircling each cylinder liner about mid-length. The air-intake manifold formed by the cylinder block connects a twin-rotor scavenger blower on the end of the engine block with the liner ports. The exhaust takes place through four valves in each cylinder head.

The engine-cooling system consists of two radiator sections attached to a removable section of the cab roof, one above either side of the engineroom. Air drawn in through grilles above the operator's cab by two large engine-driven fans is forced into the engineroom, thence up through the radiator sections and out through a central slot in the roof, through which also extends the engine exhaust pipes. This assures a minimum disturbance of the air stream over the head end of the train and insures a thoroughly ventilated engine room.

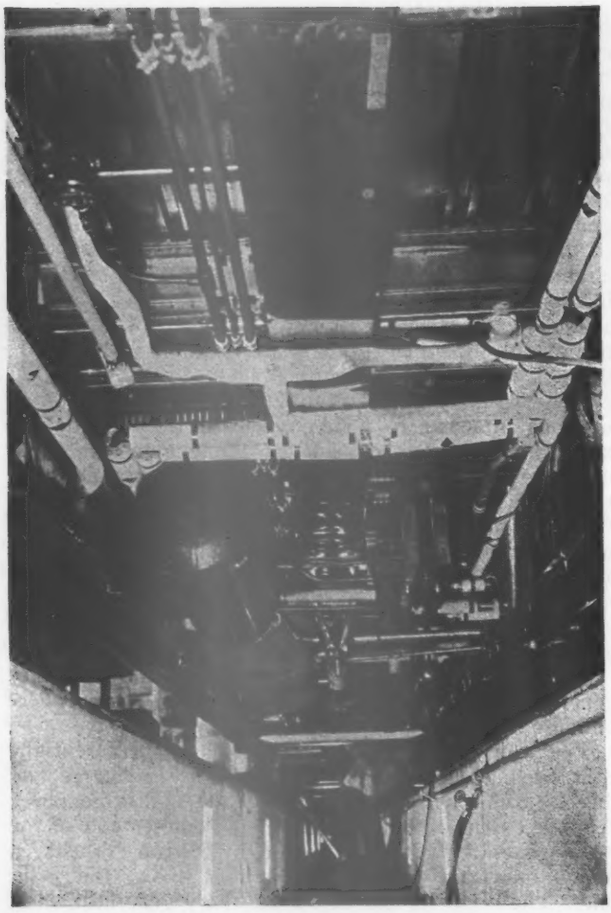
The main generator with differential exciter, auxiliary generator, pneumatic control, and traction motors were built by the General Electric Company.

The main generator is a single-bearing differentially controlled machine, placed forward of the engine and directly connected through a flexible steel-disk coupling. A shaft extension is provided at the exciter end of the main generator to drive, through Dayton V-belts, a 35-kw. auxiliary generator mounted above the main one. The opposite end of the auxiliary generator shaft is also extended for Dayton V-belt connections to the two radiator fans which draw air into the engine room.

The two series-wound traction motors are mounted on the axles of the front truck of the leading car. They have a double nose for spring support on the truck bolster. The gearing is single reduction with a 22-tooth pinion and a 61-tooth gear. The armatures have



The Winton 600-hp. two-cycle Diesel engine is built up on a welded cylinder block



Piping, wiring, tanks and air-conditioning compressors are accessible from the pit through hatches in the underbody

roller bearings. The motors are self-ventilated by multiple fans mounted at the pinion ends of the armatures. Ventilating air to the motors is taken from the engine room through ducts.

Motor control consists essentially of a master controller, electro-pneumatically operated motor contactors, and reverser, together with the necessary auxiliary magnetic contactors, switches, relays, etc. The control provides for operation from the front of the train only and for starting and stopping the engine, regulating headlights, cab lights, etc. As the train is started, the traction motors are progressively connected in series, parallel and parallel-shunted-field combinations.

The 35-kilowatt 76-volt direct-current auxiliary generator supplies power to the air compressors, air-conditioning equipment, motor for train-heating boiler, battery charging, lights, control, buffet utensils, etc., at a constant voltage regardless of load, over a range of engine speed from idling to full speed.

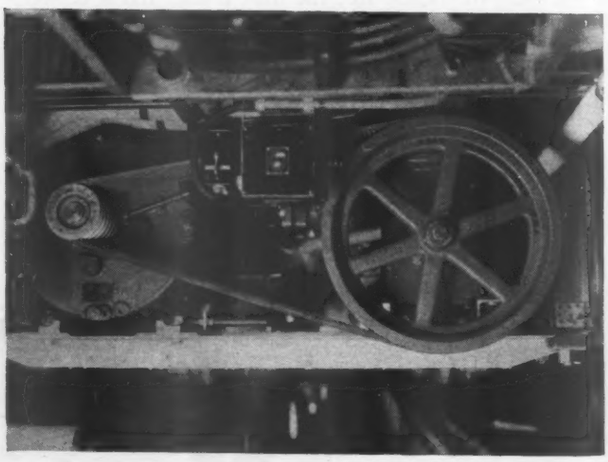
A battery is used for starting the engine, through the main generator, as well as for supplying power to the auxiliary circuits. The storage battery is an Exide 32-cell 64-volt battery, rated at 450 ampere-hours at the 10-hour discharge rate. It is arranged in tiers along the walls of the engine compartment and weighs 3,260 lb. Adequate ventilation is assured by the rapid circulation of cooling air through the engine room.

Heating and Air Conditioning

Steam heating of the Vapor type is provided by an oil-fired Peter Smith boiler with an evaporative capacity of 500 lb. per hour at a pressure of 85 lb. furnished by the Vapor Car Heating Company. This boiler is located at the front end of the baggage room in the first car. Its operation is completely automatic once the boiler has been started. The total weight of the heating plant, ready for operation, is 5,350 lb., of which 2,850 lb. is required for the water supply.

Heat is supplied to the passenger compartments from fin-tube coils in the evaporator units of the air-conditioning system, the fresh and re-circulated air passing through the units to the compartments. Steam is also supplied to a copper fin-pipe along the truss plank near the floor on each side of the compartment. The admission of steam to both radiators is controlled by a separate Vapor regulator and a magnet valve, the latter being actuated by a thermostat. The regulator reduces the steam from 75 lb. to atmospheric pressure and no high-pressure steam is used in the radiating pipes. A thermostat for the control of the air-conditioning radiators is located on a dead-light panel near the center of each compartment, about 5 ft. above the floor. The thermostat for the side-wall radiators is placed near the floor and serves to bring these radiators into action automatically when the heat distribution from the air-conditioning unit is not sufficient to maintain a predetermined temperature at the floor.

In order to reduce the weight of the water carried the radiators in the second car drain into a small sump which is inter-connected with the main boiler feed-water tanks and is automatically controlled by a float valve. As a predetermined low-water level in the sump tank is reached, the float valve admits water from the main tanks and always maintains a certain water level independent of the amount of condensation furnished by the radiators.



One of the Frigidaire air-conditioning compressor units

As the water level control in the boiler reaches the point where the feed pump is controlled, it automatically starts the pump and sends the water from the second car to the boiler in the first car. During layover period, the entire train can be heated by steam from the terminal supply.

The five passenger compartments are completely air conditioned by the Frigidaire mechanical equipment. The compressor and condenser units are housed beneath the floor of two body sections, while the evaporators and the distributing fans are built into the roof above the vestibules adjacent to all passenger compartments. This arrangement permits ready accessibility to the apparatus for repair or adjustment.

Fresh air is taken in through the doors into the vestibules and is then passed through filters where it is mixed with the re-circulated air in the proportion of about 1:5.

In the evaporator are located two combination cooling and heating coils—one at either side—and between these are two double blowers which project the conditioned air through centrally located grilles into opposite passenger compartments. The air is returned through grilles at either side of the partitions at the roof. Here, too, are located removable and washable filter pads.

The capacity of the refrigerating system is 5½ tons per car, which becomes more than ample, thanks to the double glazed windows and the heat-reflecting properties of the bright stainless-steel exterior.

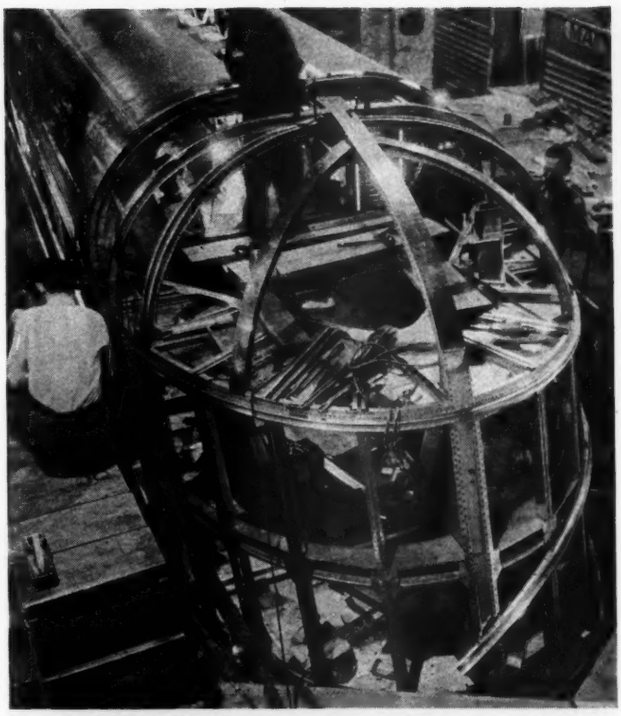
In order to supply stand-by service of the air conditioning from outside sources a special ac.-dc. feature is provided when 220-volt, 60-cycle current is applied, the dc. motor becomes a generator and charges the battery. The entire air-conditioning equipment for the train weighs approximately 4,600 lb. complete.

Copper pipes with sweated fittings have been used for the air conditioning. Furthermore, a great deal of thought has been given toward making all pipe lines and electrical connections readily accessible and to protect them from possible injury.

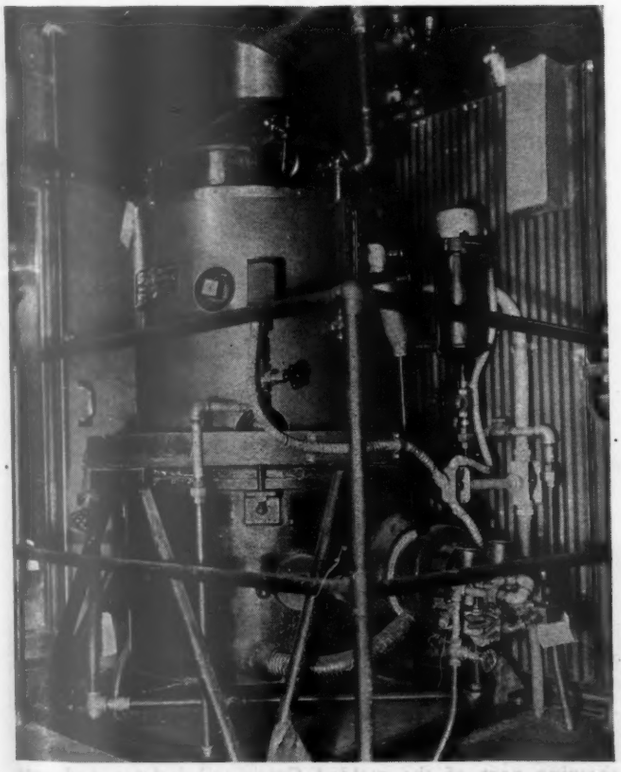
Air Brakes

The train is equipped with New York Air Brake Company's HSC equipment which has been developed for use with high-speed articulated train units and is adaptable to any length of multi-unit train. This is an electro-pneumatic brake with straight-air brake available in case of electric failure, or failure of the straight-air service brake.

Provision is made for the control of brakes by means of standard brake equipment on steam and electric locomotives, when the train is hauled dead, through the automatic brake. Emergency brake application is obtainable at any time by means of the brake valve, conductor's valve located in each car, safety control or rupture of brake pipe or connecting hose. The deadman control is operated pneumatically either by a foot pedal or by resting the weight of the hand on the brake-valve handle. The release of both of these automatically throttles the engine and causes an emergency application of the brakes. In addition, automatic sanding of the rails occurs during this emergency application.



Building the collision-resisting front-end structure



The Peter Smith heating boiler

In order to effect the high rates of retardation required to keep stopping distances from speeds in excess of 100 m.p.h. comparable to present stopping distances of steam trains from a speed of 70 m.p.h., the foundation brake system is designed for an average braking ratio of 177 per cent of light weight and 150 per cent of loaded weight at 100 lb. cylinder pressure. Pressure at full service application is 65 lb. per sq. in. The coefficient of friction of a brake shoe increases as the car speed is reduced. To correct for this and insure smooth stop a Decelakron is used. This device measures through the inertia of a moving weight, the rate of retardation of the train and adjusts the brake-cylinder pressure accordingly.

Aluminum has been used extensively in the air-brake equipment in the interest of weight reduction. This includes brake cylinders, slack adjusters, control valves, relay valves and small reservoirs, etc. The main supply and water raising system reservoirs are of stainless steel.

All air-brake equipment is conveniently located under the floor of the car and protected from freezing and accidental damage by the under sheathing of the car body. Additional protection against failure is afforded by the use of copper air pipes with sweat-on fittings which are free of scale and prevent leaks.

Lights

The front headlight is a 14-in. 250-watt, Golden Glow unit made by the Electric Service Supplies Company. The back-up light is a 9-in., 40-watt unit made by the

Interior of one of the passenger compartments

same manufacturer. The marker and classification lights are Pyle-National airplane-wind lights in housings made by the Budd Company. These lights are all built into the body of the train.

All lights inside the car and also all auxiliary apparatus are controlled through General-Electric load centers.

Indirect lighting is used in the three forward passenger sections and diffusing glass over the windows in the lounge. Electric Service Supplies Company dome lights are used in the vestibules and Safety deep-bowl units in the buffet and baggage sections.

Interior Finish

The interior of the passenger compartments is finished in a dark blue-green on the sides and ends and ivory on the ceilings. Polished strips of stainless steel extend for the full length of the sides above the windows and at the window sills. The seats are upholstered in mulberry taupe mohair with dark tan leather arm rests. The carpets are dark green under the seats and sand color in the aisle. The window drapes are lemon gold, striped with green. In the lounge two tones of dark green are used on the sides; the ceiling is old ivory; the hangings are lemon gold, striped with deep brown, and the carpet is henna rust, relieved by a stripe in lighter tone just in front of the chairs. The upholstery is green.

The choice and arrangement of colors was worked out through the collaboration of the Art and Color section of the General Motors Corporation. All floors are covered with 5/16-in. cork tile, cemented to the corrugated stainless steel flooring. In the vestibules 3/16-in. Armstrong Linotile is cemented to the cork tiling. Floors in the buffet, lavatories and luggage lockers are covered with 1/4-in. battleship linoleum.

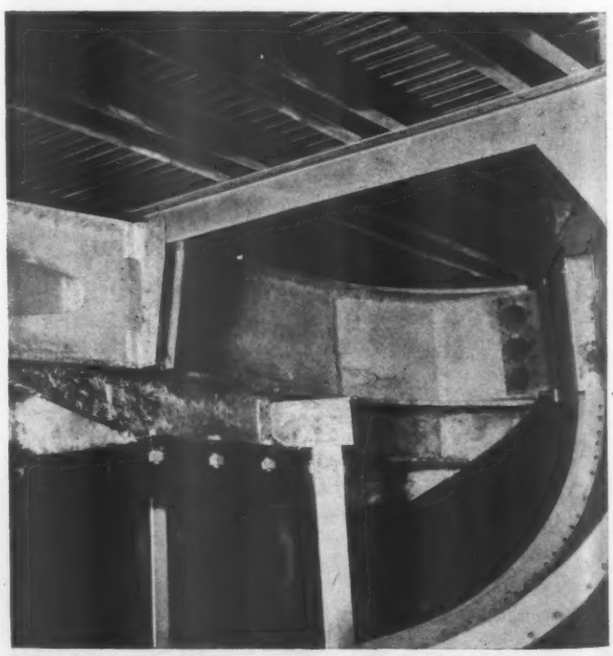
The window shades are of Pantasote with an inside facing of a neutral pattern which harmonizes with the color scheme of the interior, the outside facing having an aluminum finish which closely matches the bright stainless-steel exterior of the train.

The seats in the passenger compartments were built by the Sterling Fibre Company, and have light-weight tubular aluminum frames. The height of the seat and the angle of the seat and back have been carefully chosen for travel comfort. They are built with a clear space 8½ in. high underneath for the stowing of hand baggage. Robe rails for holding overcoats are provided at the backs of the seats. The upholstery was furnished by Massachusetts Mohair Plush Company.

The buffet is equipped to supply grill service and to serve ice cream and both hot and cold drinks. It occupies a compartment 6 ft. 6 in. long across the center of the first car. In the design of its equipment great ingenuity has been used to provide all the necessary facilities, including ample refrigerator space, electric grills, urns for hot water and coffee, storage for dishes, cupboards for storage of foods, utensils, etc. Service may be provided either at the counter or at the seats in the passenger compartments. Individual trays, which can be attached between the seats, serve as dining tables. These trays are anodized aluminum. Where opposed seats occur at the bulkheads large section tables of black, non-blistering formica may be set up. The weight of the buffet cabinets is 900 lb.

Service

After a tour of various cities on the lines of the Boston & Maine and the Maine Central the Flying Yankee will go into a service requiring a daily mileage of 730. Leaving Portland, Me., at about 7:30 a.m., it will run to Boston, a distance of 115 miles, in 105 min. It will then leave at about 9:40 a.m. for Portland and Bangor, Me., on an accelerated Flying Yankee schedule, which will reduce the overall time by 1 hr. 55 min. each way. After the return trip arriving at Boston early in the evening, an evening run to Portland will complete the day. For the non-stop runs between Boston and Portland the schedule will call for an average speed of over 65 m.p.h. For the 135 miles between Portland and Bangor the schedule will require an average of over 52 m.p.h., including 14 intermediate stops each way.



Looking up under the floor at the rear end of the train, showing part of the welded Cromansil bolster and rear center member

Stress Distribution in Aluminum Connecting Rods[1]

Studies and investigations utilized in development of an improved design of locomotive side rods

By R. L. Templin[2]

LIMITATIONS of available space in the main driving wheels of large freight locomotives frequently preclude the provision of desired amounts of counterbalance weight when using the ordinary types of steel rods. The use of crossbalancing methods, such as that given by Fry,[3] may appreciably decrease the dynamic augments resulting from such conditions of underbalance. It would seem, however, that considerably more gain would be made if lighter rods could be used on such locomotives. With lighter-weight rods and lighter counterbalances the out-of-plane forces would also be diminished.

In view of the marked advance which has been made in the development of high-strength light alloys, especially those of aluminum, it would seem that a suitable material for locomotive rods might be found in that field. At the present time one of these alloys is of particular interest because of its mechanical properties and its availability in forgings of sizes suitable for the largest rods. Locomotive rods of this metal have been in use experimentally for a number of years with quite satisfactory results. The metal is designated commercially as 25S-T and has the following nominal chemical composition:

	Per cent
Copper	4.4
Silicon	0.8
Manganese	0.75
Aluminum	Remainder

Extensive tests have been carried out on the metal in the form of large rod forgings and the mechanical properties indicated in Table I obtained. Nine standard test specimens were taken—longitudinal, transverse, parallel and transverse normal to plane of web—each at three locations.

Comparison of these properties with those of the steels ordinarily used for locomotive rods reveal marked differences which may at first appear disturbing. With a reasonable knowledge of service conditions the magnitude of the stress concentration factors involved and the properties of the newer material, however, rods should be designed which are considerably lighter and yet will give service quite as satisfactory as that obtained from steel rods.

Purpose and Scope of Investigation

The purpose of this paper is to describe certain studies and tests that have been made (1) to determine the stress concentration factors occurring in models of pin-end members under both tensile and compressive forces; (2) to evolve a new design of rod end with the intention of eliminating some of the very high stresses; (3) to confirm the validity of these changes in design by model tests; (4) to compare the results from some of the models with those obtained from tests of a full-sized rod end, and (5) to correlate in so far as possible tests

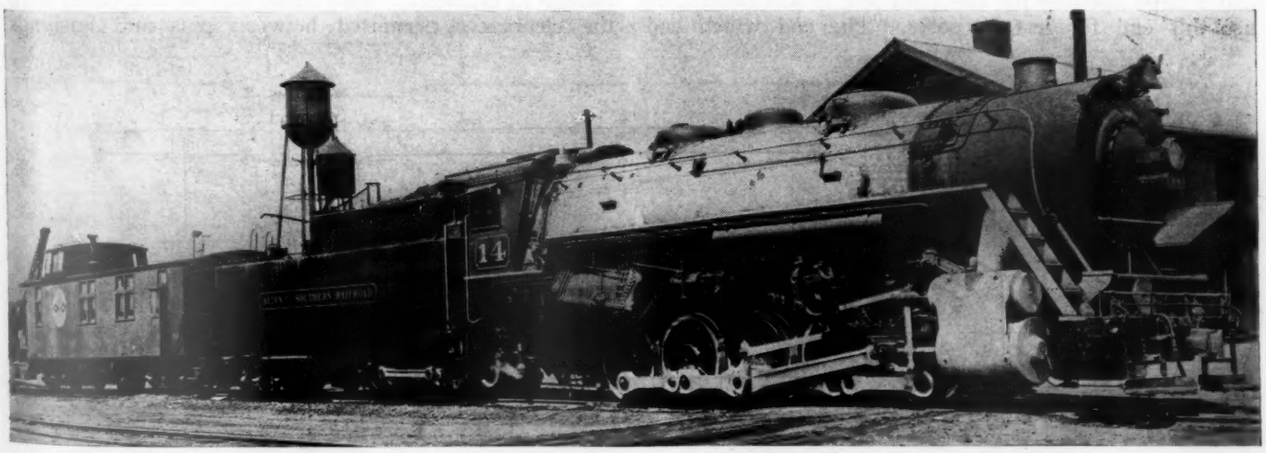
Table 1—Mechanical Properties of 25S-T Locomotive Main-Rod Forgings

	Min.	Gen. Avg.
Tensile strength, lb. per sq. in.	50,200	55,330
Yield strength, lb. per sq. in.	31,800	35,130
Elongation in 2 in., per cent	8.0	13.7
Endurance limit, lb. per sq. in.	11,500	12,600
Brinell hardness	107	110
Shearing strength, lb. per sq. in.	.....	35,000
Young's modulus of elasticity, lb. per sq. in.	.....	10,000,000

[1] Abstract of a paper presented before the Railroad Division of the American Society of Mechanical Engineers at the annual meeting, December 4, 1934.

[2] Chief engineer of tests, Aluminum Research Laboratories, Aluminum Company of America.

[3] Locomotive Counterbalancing, Lawford H. Fry, Transactions of A.S.M.E., Vol. 56, No. 6, June, 1934, p. 431. Abstract, *Railway Mechanical Engineer*, February, 1934, page 42, and March, 1934, page 79.



Alton & Southern locomotive No. 14 with dynamometer car attached for road test of aluminum rods

made under service conditions with results obtained in the laboratory. The work included laboratory tests of 15 models of pin-end members; tests of a full-size aluminum alloy rod end; tests of a model of the new design of a particular rod end, and field tests of some rods on a large 0-10-0 locomotive under service conditions.

In the preliminary tests of 15 models consideration was given to distribution of material around a circular hole; effect of press and loose-pin fits, and shape and types of fillers corresponding to brasses in the wrist-pin end of main rods. Strain measurements were obtained by Huggenberger tensometers by means of which stresses equivalent to about 80 lb. per sq. in. may be observed. In converting strain readings into stress a modulus of elasticity of 10,000,000 lb. per sq. in. was used.

Tests showed, among other things, that the use of loose fitting pins may cause a marked increase in the ratio of the maximum measured to average computed stresses. It may be inferred from what has been pointed out that as wear occurs in locomotive side rod bushings and pins the stresses in the rod ends increase and under some conditions might be expected to become double their initial working value at certain critical locations. It would also appear that more attention should be given to the magnitude of the press-fits used for bushings in side rods. Within certain limits the greater the tolerance used for making a press-fit the less the stress ranges under service conditions. Obviously, there must be a limit to the amount of tolerance allowed in making press fits. So far the tests under discussion have not been extended to define this limit. The results from these model tests, however, indicate that initial stresses set up in full-size locomotive rods using different press-fit tolerances can be determined, as well as the stress ranges caused by the computed working loads. Consideration of these stress ranges and the safe stress ranges obtained from fatigue tests of the material should permit of an intelligent design of rods which would insure safety against fatigue failure.

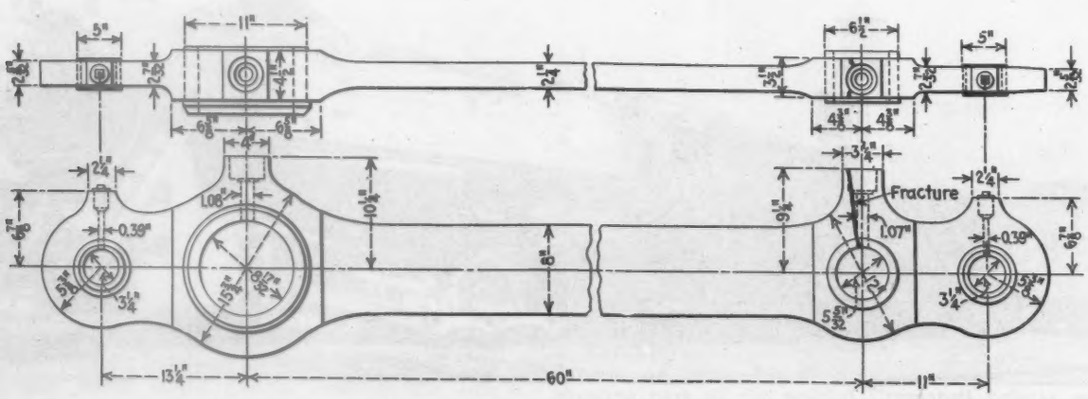
Test of a Full-Size Locomotive Side-Rod End

Aluminum alloy side rods have been used for a number of years on the locomotives of the Alton & Southern. The intermediate rods on one of the engines (No. 13) failed in fatigue after 89,619 miles of service. The fatigue fracture was in a plane normal to the axis of the rod, coinciding approximately with the vertical diameter of the pin and the large grease outlet above it. Since the other end of the rod was similar in design and had a large opening for the main pin, it was decided to use this end for test purposes. The end which had failed was first cut off, then the shank of the rod machined down so that it would fit in the jaws of the testing machine and a special pin provided with a recess of such size as to give adequate clearance for a Huggenberger tensometer. With this arrangement and an enlarged hole through the bushing in the rod it was possible to measure stresses at the edges of the grease outlet while the whole assembly was under various tensile or compressive loads. In addition, stress measurements were made on the rod at various other locations.

Application of the design loads of 30,000 lb. on the knuckle pin and of 60,000 lb. on the crank pin developed stresses at the knuckle pin up to 7,500 lb. per sq. in. on the outside of the rod and internal stresses at the grease outlet of 14,200 lb. In the reduced section between the knuckle pin and the crank-pin stresses ran up to 3,500 lb. At the crank-pin section stresses ranged up to 5,000 lb. on the outside and up to 9,500 lb. internal at the grease outlet.

It will be noted that the stresses adjacent to the grease outlet were high when compared with other stresses. These maximum measured values, however, do not represent the actual maximum values obtaining, either under the laboratory test loading or under service conditions, because the ½-in. gage length of the strain gages used in making the measurements is of the same order of magnitude as the diameter of the grease outlet. The strain measurements obtained with such a gage are, of course, the total strains occurring over the gage length used. In using values obtained with such an instrument the assumption must be made that the stress is uniformly distributed over the gage length. Obviously this is not the case in this particular instance, with the result that the actual stresses at the side of the grease outlet must undoubtedly be considerably higher than those indicated in the tests. Furthermore, the estimated design loads used in determining the laboratory test loads would take no account of stresses caused by dynamic loading nor of those caused by unequal distribution of loads. Such being the case, it is not difficult to understand why the rod suffered a fatigue fracture at the location indicated under service conditions.

In the tests of the full-size rod end, as in the case of some of the models, it was found that the clearance between the pin and bushing had an important effect upon the maximum stresses in the rod. For example, it was found that stresses at the section through the main pin were approximately doubled by removing the support of a close fitting main pin when the load was applied to the knuckle pin. The distortion of the main pin opening, under this loading condition, amounted to only 0.025 in. change in diameter. This value may be compared with the clearances permitted between pins and bushings



Left intermediate side rod of Alton & Southern locomotive No. 13 showing location of failure

under service conditions before new pins or bushings are fitted. It is not uncommon to find clearances as much as $\frac{3}{32}$ in. between pin and bushing diameter on locomotive rods.

Tests were made to determine the pressure required to push the bushings from the rod, the amount of stress release caused by removal of the bushings and the tolerances provided for making the push fit of the bushings in this particular rod. It took a pressure of 5,400 lb. to push out the knuckle-pin bushing, the tolerance on the bushing being .002 in. and the measured stress in the rod 2,300 lb. per sq. in. To remove the main pin bushing took a pressure of 23,200 lb., the tolerance of the bushing being .008 in. and the maximum stress in the rod, 4,400 lb. The stress concentration ratios were undoubtedly influenced by the initial stresses produced by the push fit of the bushings. From the data obtained in the tests of the full-size rod, it was not possible to determine accurately the maximum stress concentration ratios for the rods without the press-fit bushings. It would seem reasonable to expect, however, that if the load were sufficient to relieve the initial compression in the bushing, the maximum stresses measured would not be appreciably different from those which would have been obtained if there had been no press fit. If the bushing stresses were only partially relieved, the maximum stresses in the rod would be more than equivalent to the load applied on the pin and, therefore, high stress concentration factors would be obtained. The most advantageous press fit, as far as the stresses around the pin are concerned, would appear to be one in which the total compression in the bushing is just relieved by the design load on the pin. Under such a condition the stress range in the rod would be reduced, yet the maximum stress would not greatly exceed that produced without the press fit.

The measured stresses adjacent to the grease outlet for the main pin of the full-size rod indicated clearly that the location of this outlet was unfortunate because of the resulting high stresses. The location was, in fact, probably the worst which could have been selected. When the locations of high stresses resulting from service load are known, it would appear obvious that such places should be avoided when locating grease outlets, keyways, or other openings of similar character. Such openings are bad stress raisers and, when unavoidable, should at least be located in the regions of minimum stress if possible. With these facts in mind a new design was made for a rod to replace the one which failed in service. A new rod is now being made according to this design and will be put into service shortly. In order to obtain a better idea of what has been accomplished in lowering the stress concentration factors by the new design, a half-size model was made of the larger end of the rod and tested in the laboratories.

Tests of Half-Size Model of New Design of Side Rod

The new design of rod for Alton & Southern locomotive No. 13 embodied two important changes: (1) The width of the shank was reduced from 8 in. to 5 in., effecting a weight saving of about 40 per cent in this part of the rod, and (2) all grease outlets at the pins

Table II—Summary of Tests on Model of Alton & Southern Intermediate Rod

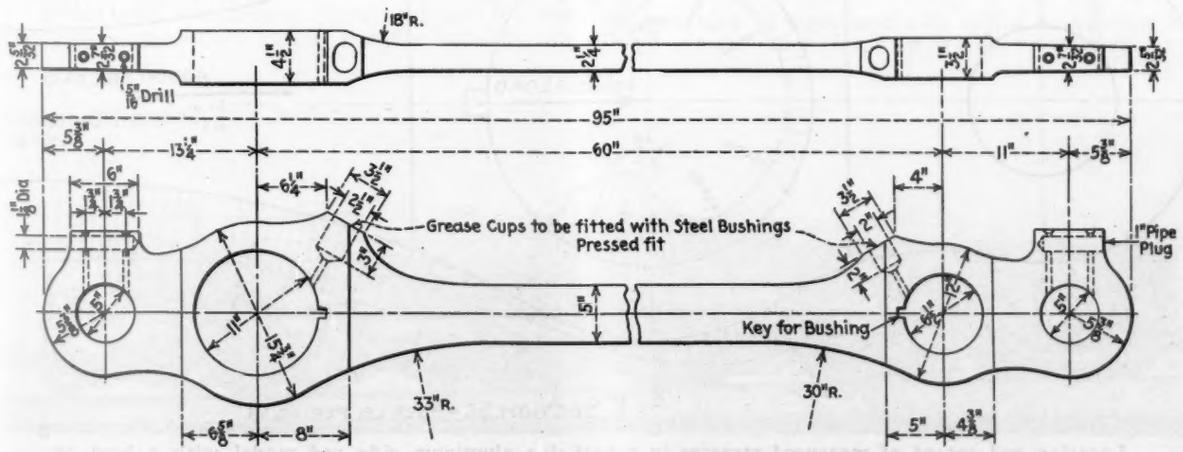
Loading condition	Section†	Maximum measured stress, lb. per sq. in.	Average computed stress, lb. per sq. in.	Ratio maximum measured stress to average computed stress
20,000 lb. on knuckle pin without main pin	A-A	17,700	6,570	2.69
	B-B	18,300	4,540	4.03
	C-C	20,000	4,760	4.20
	D-D	.....	9,000	....
20,000 lb. on knuckle pin with main pin	A-A	19,200	6,570	2.92
	B-B	12,400	4,540	2.73
	C-C	8,400	4,760	1.76
	D-D	.....	9,000	....
40,000 lb. main pin	C-C	21,500*	9,525	2.26
	D-D	.....	18,000	....
4,000 lb transverse load on main pin	B-B	3,800	2,000**	1.90
	C-C	2,800	1,500	1.86
	D-D	16,000	16,600	0.96

†Section A-A is through knuckle pin; B-B through reduced section between knuckle and crank pins; C-C through main pin, and D-D through shank of rod.
*Maximum stress 15 deg. from section C-C.
**Computed bending stresses.

Table III—Estimated Maximum Stresses in New Alton & Southern Intermediate Rod, Based on Model Tests, Compared with Similar Stresses in Older Design of Rod

Test	Loading Conditions	Maximum stresses, lb. per sq. in.			
		Knuckle pin, section A-A	Shank section B-B	Main pin section C-C	Shank section D-D
1	30,000 lb. design load on knuckle pin. (Equivalent load on model = 5,900 lb.)	(1)* 5,700 (2) 4,600	3,700	(1) 2,500 (2) less than 25,000	.....
1A	Maximum stresses for same loadings on old rod.	(1)* 7,500 (2) 13,600	3,500	3,500	.....
2	60,000 lb. design load on main pin. (Equivalent load on model = 11,900 lb.)	.....	.....	(1) 6,400 (2) less than 6,400	5,400
2A	Maximum stresses for same loading on old rod.	.....	.....	(1) 5,000 (2) 9,100	-3,300

*(1) Stresses on side of rod.
*(2) Estimated stresses at edge of grease outlet.
Note: Stresses in old rod included stresses produced by the press-fit of the bushings.



New intermediate side rod for Alton & Southern locomotive No. 13

were moved from sections of maximum stress to points of comparatively low stress. The half-size model of the new design was loaded successively on both the knuckle pin and the main pin, using loads several times the equivalent of the design values for the full-size rod. The testing procedure was similar to that for the other models tested. In addition, this model was tested as a simple beam in order to simulate the loads in service produced by whipping or vertical inertia forces on the rod. The results obtained are given in Table II. The distribution of the measured stresses with a load of 40,000 lb. on the main pin are shown also in one of the illustrations.

From the results obtained in these model tests and those obtained on the full-sized rod of the old design an estimate has been made of the probable maximum stresses that will occur in the new rods. These estimated maximum stresses are shown in Table III.

Field Tests of Full-Size Rods Under Service Conditions

A few tests under service conditions were made on Alton & Southern locomotive No. 14 during the summer of 1933. These tests were carried out in co-operation with the University of Illinois, the Alton & Southern and the Aluminum Company of America. Data pertaining to this particular locomotive are given in Table IV.

Table IV—Specifications of Alton & Southern Locomotive No. 14

Type of locomotive	0–10–0
Cylinder size	28 in. by 30 in.
Steam pressure—nominal	230 lb.
Diameter of drivers	57 in.
Tractive force of locomotive proper	80,500 lb.
Tractive force of booster	15,000 lb.
Weight of engine proper	324,000 lb.
Weight of tender	235,000 lb.
Total weight	559,000 lb.
Run out mileage to Aug. 24, 1933	37,800 miles
Weight of No. 1 main rod (aluminum)	536 lb.
(steel)	950 lb.
Weight of No. 2 rear rod (aluminum)	144 lb.
(steel)	270 lb.
Weight of No. 3 rear intermediate side rod (aluminum)	235 lb.
(steel)	460 lb.
Weight of No. 4 front intermediate side rod (aluminum)	415 lb.
(steel)	805 lb.
Weight of No. 5 front side rod (aluminum)	140 lb.
(steel)	266 lb.
Total weight of aluminum rods (one side)	1,470 lb.
Total weight of steel rods (one side)	2,751 lb.
Total weight saved (one side)	1,281 lb.

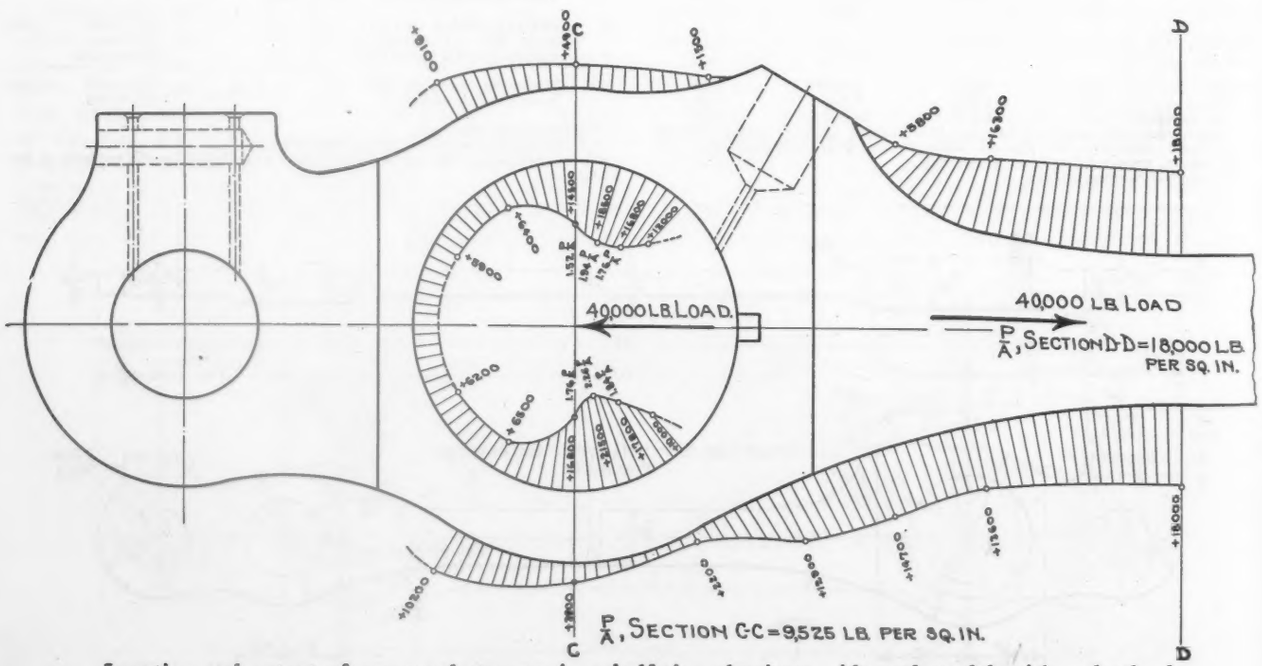
The dynamometer car,[4] jointly owned by the Illinois Central and the University of Illinois, was directly coupled to the tender of the engine and this arrangement used throughout the service test when hauling loads. Complete dynamometer-car records of the usual type were obtained while stresses were measured on each of the main rods of the locomotive and two intermediate rods on opposite sides of the locomotive.

For making strain measurements on the locomotive rods the Baldwin-Southwark-de Forest recording extensometer was used. This instrument consists essentially of a specially cut diamond attached to one set of gage points and a polished stainless steel or chromium plated brass target attached to another set of gage points. In operation a diamond is made to bear against the target and any change in strain in the member under test causes the diamond to scratch a record on the target. The holder in which the target is mounted is pivoted and a spring tends to pull it at right angles to the axis of the instrument, while an adjustable friction brake tends to prevent sidewise movement. When the metal between the gage points is subjected to a change in strain, the friction between the target carrier and the brake is decreased and the target moves sidewise a small amount so that the record is spread out in saw-tooth form. The instrument has no magnification factor other than that obtained from the 3-in. gage length. In order to evaluate the strain from the records it is necessary to photograph the target at magnification of from 100 to 500 diameters. With the strain values and the modulus of elasticity of the material the stresses can be readily determined.

The results obtained from the strain measurements together with other pertinent data were summarized. These

(*Continued on page 100*)

[4] University of Illinois Engineering Experiment Station Bulletin, No. 43.



Location and extent of measured stresses in a half-size aluminum side rod model with a load of 40,000 lb. on the main pin

Articulated Locomotives for Pittsburgh & West Virginia

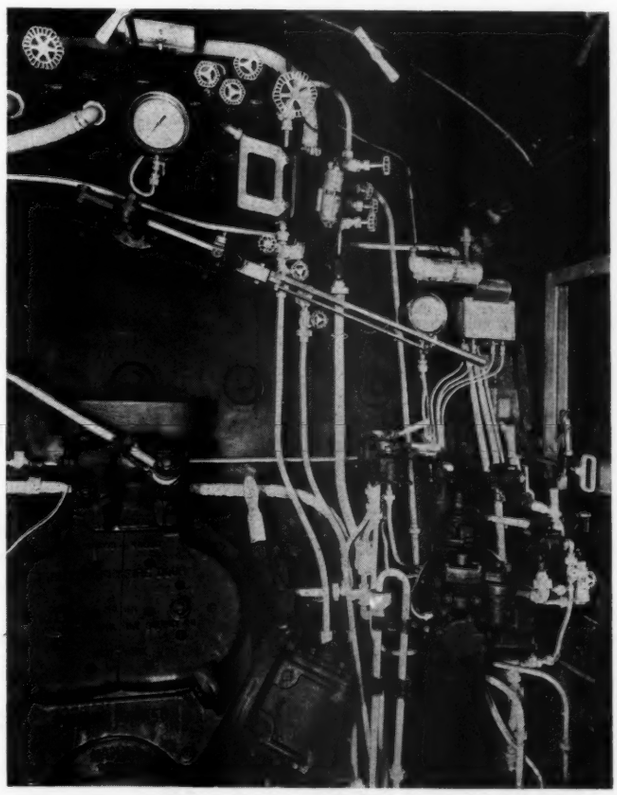
Three single-expansion articulated 2-6-6-4 type locomotives built by Baldwin have 97,500 lb. rated tractive force, exclusive of auxiliary locomotive, and will replace old Consolidations

THE Pittsburgh & West Virginia is a short road—138 miles long—connecting the rich coal fields of western Pennsylvania with the Pittsburgh district and thence across the upper end of West Virginia into Ohio. Its traffic is heavy and consists largely of soft coal. Heretofore this traffic has been handled by 22 Consolidation and three Mikado locomotives. Of the 2-8-0 type locomotives which were built between 1907 and 1921 nineteen have 58-in. drivers and a rated tractive force ranging from 54,000 lb. to 58,600 lb. The three 2-8-2 type locomotives which were built in 1918 have a rated tractive force of 54,725 lb.

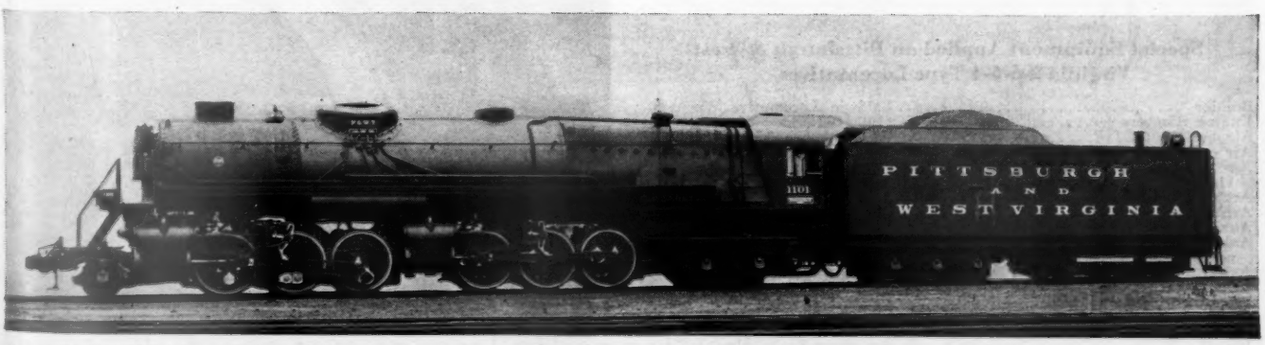
Three new single-expansion articulated locomotives built by the Baldwin Locomotive Works have recently been placed in service. These locomotives have a rated tractive force of 97,500 lb. for the locomotive itself. This may be supplemented by a Bethlehem auxiliary locomotive developing 16,000 lb. additional tractive force which is applied to the rear six-wheel tender truck. One of the new locomotives is thus capable of performing the work formerly requiring the use of two of the older locomotives. They will be employed mainly for hauling coal trains on the 35½-mile run from Connellsville, Pa. to Rook, Pa., a suburb of Pittsburgh. In the preparation of the design the builders were restricted to an axle load of 65,000 lb., a track curvature of 18 deg., and to certain specified clearances. The stack height is 16 ft. 2 in.; the cab width, 10 ft. 6 in., and the width over running boards, 11 ft. 4 in.

Boiler and Accessories

The boiler is of the straight-top, wagon-bottom type with a Belpaire firebox, the outside diameter of the first one of the three shell courses being 94 in. The firebox has a length of 144⅛ in. and a width of 102¼ in., which provides a grate area of 102.3 sq. ft. The combustion chamber is 74 in. long and the Security brick arch is carried on five seamless steel arch tubes. The length over tube sheets is 23 ft. and the total length of the boiler and smokebox, 53 ft. 8⅜ in. The evaporative heating surface is 5,914 sq. ft. The superheater is Type A with 1,873 sq. ft. surface. Coal is fed to the grate by a Hanna stoker. Shell and firebox sheets are of O.H. basis steel, the former being supplied by the United States Steel Corporation and the latter by the



General view of right-hand side of the back boiler head in the cab of the P. & W. Va. locomotive



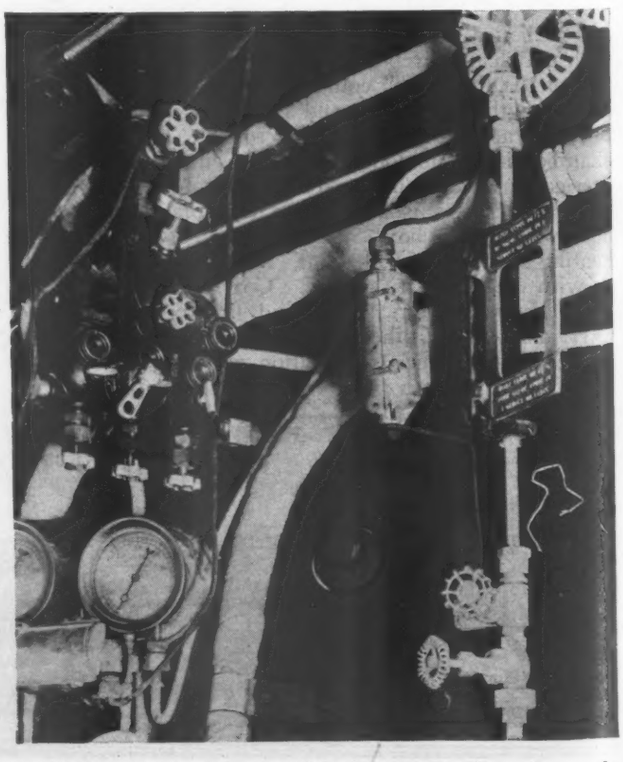
Single-expansion articulated locomotive built for the Pittsburgh & West Virginia by the Baldwin Locomotive Works

Principal Dimensions, Weights and Proportions of the Pittsburgh & West Virginia 2-6-6-4 Type Locomotives

Railroad	Pittsburgh & West Virginia
Builder	Baldwin Locomotive Works
Type of locomotive	2-6-6-4
Road numbers	1100-1102
Service	Freight
Cylinders, diameter and stroke	4—23 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Maximum travel	6 in.
Steam lap	1 1/16 in.
Exhaust clearance	None
Lead in full gear	3/16 in.
Cut-off in full gear, per cent	81½
Crank throw	14 1/16 in.
Weights in working order:	
On drivers	397,300 lb.
On front truck	27,540 lb.
On trailing truck	103,200 lb.
Total engine	528,040 lb.
Tender	377,600 lb.
Wheel bases:	
Driving	32 ft. 7 in
Rigid	11 ft. 0 in.
Total engine	55 ft. 8 in.
Total engine and tender	98 ft. 4 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	36 in.
Trailing truck	42 in.
Journals, diameter and length:	
Driving, main	11 in. by 14 in.
Driving, others	11 in. by 14 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Belpaire, straight-top, wagon bottom
Steam pressure	225 lb.
Fuel	Soft coal.
Diameter, first ring, outside	94 in.
Firebox, length and width	144⅛ in by 102¼ in.
Height mud ring to crown sheet, back	75½ in.
Height mud ring to crown sheet, front	95½ in.
Arch tubes, number	5
Combustion chamber length	74 in.
Tubes, number and diameter	241—2¼ in.
Flues, number and diameter	66—5½ in.
Length over tube sheets	23 ft.
Grate area	102.3 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	450 sq. ft.
Arch tubes	49 sq. ft.
Total firebox	499 sq. ft.
Tubes and flues	5,414 sq. ft.
Total evaporative	5,913 sq. ft.
Superheating (Type A)	1,873 sq. ft.
Comb. evaporative and superheating	7,786 sq. ft.
Feedwater heater	None
Tender:	
Style	Rectangular
Water capacity	2,000 gal.
Fuel capacity	20 tons
Trucks	Six-wheel
General data estimated:	
Rated tractive force, 81½ per cent	97,500 lb.
Rated tractive force, aux. locomotive	16,000 lb.
Speed at 1,000 ft. piston speed	35.16 m.p.h.
Piston speed at 10 m.p.h.	284.5 ft.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	75.2
Weight on drivers ÷ tractive force	4.08
Weight engine ÷ comb. heat. surface	68.0
Boiler proportions:	
Tractive force ÷ comb. heat. surface	12.78
Tractive force × dia. drivers ÷ comb. heat. surface	799
Comb. heat. surface ÷ grate area	76.2
Firebox heat. surface ÷ grate area	4.87
Firebox heat. surface, per cent of evap. heat. surface	8.45
Superheat. surface, per cent of comb. heat. surface	24.1

Special Equipment Applied on Pittsburgh & West Virginia 2-6-6-4 Type Locomotives

Builder	Baldwin Locomotive Works
Engine numbers	1100-1102
Air brakes, 6-ET	Westinghouse Air Brake Co.
Air compressors—2, 8½-in. c.c.	Westinghouse Air Brake Co.
Air reservoirs, enameled—2-20½ in. by 114 in.	Westinghouse Air Brake Co.
Arch, brick—Security	American Arch Co.
Arch tubes (seamless)	National Tube Co.
Auxiliary locomotive (six-wheel tender)	Bethlehem Steel Co.
Axles, driving and truck—O. H. steel, annealed	Standard Steel Works Co.
Axles, tender—Carbon steel, annealed	Standard Steel Works Co.
Bell ringer	Viloco Railway Equip. Co.
Blower fitting, smokebox	Barco Manufacturing Co.
Blower valve—Renewo	Lunkenheimer Co.
Blow-off valves—Close clearance	Wilson Engineering Co.
Brakes, driver	American Brake Shoe & Fdry. Co.
Brakes, tender truck—Clasp	American Steel Foundries
Buffer, radial—Wedge type	Franklin Ry. Supply Co.
Check valve, injector	Consolidated Ashcroft Hancock Co.
Coupler, engine—Type D	National Malleable & Steel Castings Co.
Coupler, tender—6-in. by 8-in. shank	National Malleable & Steel Castings Co.
Cradle, frame	General Steel Castings Corp.
Crosshead wrist pin—Carbon steel, annealed	Standard Steel Works Co.
Cylinder cocks	Okadee Co.
Draft gear, tender—A-22-XB	W. H. Miner
Draft-gear attachments—Farlow	Symington Co.
Drain valves, cylinder saddle and stoker	Okadee Co.
Drawbar—Unit Safety	Franklin Ry. Supply Co.
Driving-box grease cellar	Franklin Ry. Supply Co.
Dust guards, tender—Basswood	Cottman Co.
Dust-guard closures	Cottman Co.
Fire door—No. 8	Franklin Ry. Supply Co.
Flexible connections, aux. loco.	Barco Manufacturing Co.
Frames, locomotive	General Steel Castings Corp.
Frame, tender—Open bottom	General Steel Castings Corp.
Gages, steam—AA-110	Crosby Steam Gage & Valve Co.
Headlight—18-in.	Sunbeam Electric Mfg. Co.
Headlight generator—No. 3	Sunbeam Electric Mfg. Co.
Hinges, smokebox	Okadee Co.
Injector, live steam—Chicago Class T	Obio Injector Co.
Injector, starting valve	Obio Injector Co.
Lagging, boiler (1)	Phillip Carey Mfg. Co.
Lagging, boiler (2)	Johns-Manville Sales Corp.
Lubricator, hydrostatic—No. 22 triple-feed, Bullseye	Detroit Lubricator Co.
Lubricator, mechanical	Nathan Manufacturing Co.
Netting, smokebox	John A. Roebling's Sons Co.
Packing, throttle and miscel.	Garlock Packing Co.
Packing, rod and valve stem	Paxton-Mitchell Co.
Pipe covering, steam	Johns-Manville Sales Corp.
Pipe fittings, compression	Parker Appliance Co.
Plugs, arch tube	T-Z Ry. Equip. Co.
Plugs, washout	T-Z Ry. Equip. Co.
Reverse gear, Type C	Baldwin Locomotive Works
Safety valves	Consolidated Ashcroft Hancock Co.
Sanders—King	U. S. Metallic Pack. Co.
Steam trap, aux. loco.—No. 8	Sarco Co.
Steel sheets, boiler (basic)	U. S. Steel Corp.
Steel sheets, firebox (basic)	Otis Steel Co.
Stoker	Hanna Stoker Co.
Superheater—Type A	Superheater Co.
Tank valves—Wedge, flanged	Lunkenheimer Co.
Tank-valve gasket	Acme Mfg. & Gasket Co.
Tank strainer	Beckley Perforating Co.
Throttle valve—Glaenzer poppet	Baldwin Locomotive Works
Tires, driving—Carbon steel	Edgewater Steel Co.
Truck, trailing—Delta	General Steel Castings Corp.
Truck, tender—Six-wheel	General Steel Castings Corp.
Truck, tender, journal boxes and lids	Symington Co.
Tubes and flues—Seamless steel	National Tube Co.
Valves, cab—Renewo	Lunkenheimer Co.
Water gage—Reflex C-5	Nathan Mfg. Co.
Wheels, engine truck—Rolled steel	Standard Steel Works Co.
Wheels, trailer truck—Cast steel	Standard Steel Works Co.
Wheels, tender—Rolled steel	Standard Steel Works Co.



Left-hand water column with frame showing change in water level on 1½ per cent grades

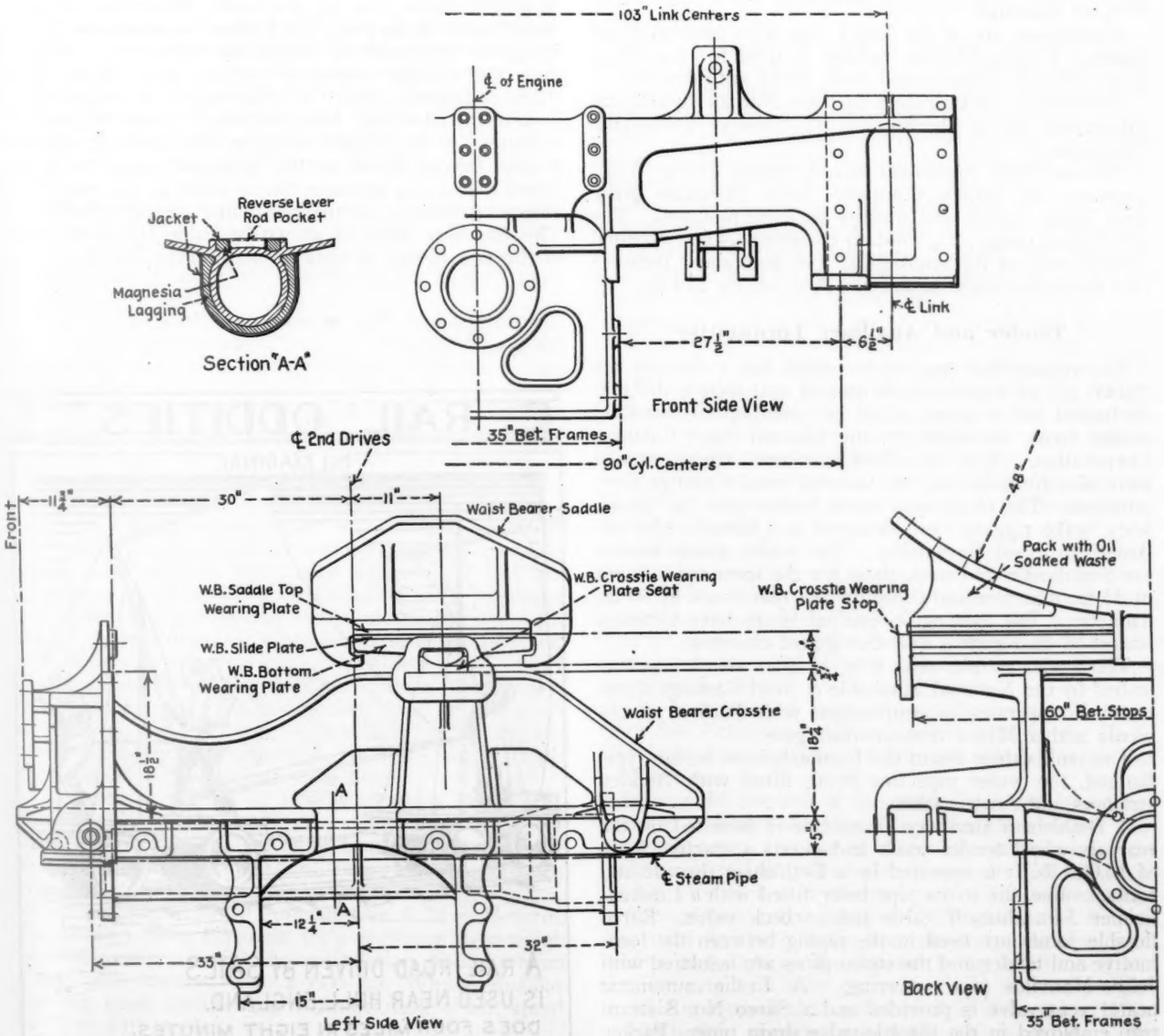
Otis Steel Company. All tubes and flues are of National seamless steel. The boiler pressure carried is 225 lb. No feedwater heater was applied. The boiler is fed by two Chicago Type T injectors furnished by the Ohio Injector Company through Hancock check valves mounted on the right and left sides of the first shell course.

Observation of the cab photographs shows an interesting and simple device provided to show the change in the indicated water level due to grade. This consists of a rectangular frame attached to the water columns on the right- and left-hand sides. The width of the opening is equal to the change in water level due to a change from an up-hill to a down-hill grade of 1½ per cent. The wording cast on the top of the frame reads: "Water level on 1½ per cent up-grade equal to two gages on level" and on the bottom of the frame "Water level on 1½ per cent down grade equal to two gages on level."

Other boiler mountings and trimmings included are Franklin Butterfly No. 8A automatic fire door, T-Z boiler plugs, two Wilson close-clearance blow-off valves, Consolidated safety valves, Crosby steam gages, Renewo blower valves, Barco blower fittings, King sanders, Viloco bell ringer, Sunbeam No. 3 turbo headlight generator, and Sunbeam 18-in. headlight mounted on a bracket attached to the upper deck in front of the smokebox.

Foundation and Running Gear

The frame structure is of the built-up type with cast-iron cylinders, cast-steel bumper and a cast-steel cradle. The driving wheels are 63 in. in diameter and the wheel base of each engine is 11 ft. The two-wheel engine truck is of the Commonwealth type with outside bearings, while the four-wheel trailer truck is of the Delta type. Axles for driving, engine truck and trailing truck are of open-hearth carbon steel, annealed, furnished by the Standard Steel Works. Standard rolled steel wheels are used for the engine trucks and 42-in. cast-steel wheels for the trailing truck. Franklin grease cellars are fitted to the driving boxes. Connection between engine and tender is by means of a Unit-Safety drawbar used in



A section of the steam pipe to the rear engine is made a part of the waist bearer on the forward portion of the P. & W. V. articulated locomotive

connection with a Franklin radial buffer of the wedge type.

A new and particularly interesting design has been worked out by the Baldwin Locomotive Works for the waist bearer between the front engine frame and the boiler. By reference to the drawing it will be noted that it is unique in that the middle portion of the central steam pipe is incorporated as a part of the casting itself. The upper portion of the waist bearer was designed to meet unusual conditions of limited vertical space between the driving wheels and the boiler.

Driving Gear and Controls

All four cylinders are 23 in. in diameter with a stroke of 32 in. Valve gear is of the Walschaert type, operating 12-in. piston valves having a maximum travel of 6 in. Crank throw is 14 7/16 in.; steam lap, 1 3/16 in.; no exhaust clearance; lead in full gear, 3/16 in., and cut-off in full gear 81.5 per cent. The power reverse gears are Baldwin, Type C, with Bethlehem reverse-gear interlock. The throttle is of the Glaenzer poppet valve type, located in the dome and inside connected. Garlock packing is used in the throttle-valve stuffing box. The dry pipe is 9 in. in diameter.

Crossheads are of the Laird type with multiple-ledge guides. Paxton-Mitchel packing is used for the piston rods. Okadee cylinder and drain cocks are provided.

Lubrication is furnished by two Nathan mechanical lubricators and a Detroit No. 22 Bullseye hydrostatic lubricator.

The air-brake equipment was furnished by the Westinghouse Air Brake Company, being Schedule 6-ET with brake valves and fittings pedestal mounted. The two 8½-in. cross-compound air compressors are mounted on the front of the smokebox. The equipment includes two enamelled main reservoirs 20½ in. by 114 in.

Tender and Auxiliary Locomotive

The rectangular type tender which has a capacity for 20,000 gal. of water and 20 tons of coal weighs 377,600 lb. loaded and is mounted on an open-bottom cast-steel tender frame furnished by the General Steel Castings Corporation. The six-wheel cast-steel tender trucks were also furnished by the General Steel Castings Corporation. The clasp type truck brakes and the tender body brake rigging were designed and furnished by the American Steel Foundries. The tender truck wheels are Standard rolled steel, those for the front truck being of 33 in. diameter and those for the rear truck of 36 in. diameter. The Symington journal boxes have Cottman basswood dust guards and dust-guard closures.

The tender coupler with 6-in. by 8-in. shank was furnished by the National Malleable & Steel Castings Company and operates in conjunction with Farlow attachments and a Miner friction draft gear.

The tank valves are of the Lunkenheimer wedge type, flanged, the water pipe line being fitted with Beckley strainers and Acme gaskets.

A Bethlehem auxiliary locomotive is mounted on the rear six-wheel tender truck and exerts a tractive force of 16,000 lb. It is operated by a Bethlehem throttle and control valve, the steam pipe being fitted with a Lunkenheimer 3-in. shut-off valve and a check valve. Barco flexible joints are used in the piping between the locomotive and tender and the steam pipes are insulated with Johns-Manville pipe covering. A Leslie automatic heater vent valve is provided and a Sarco No. 8 steam trap employed in the throttle-valve drain pipe. Parker compression fittings are used for the control-pipe connections.

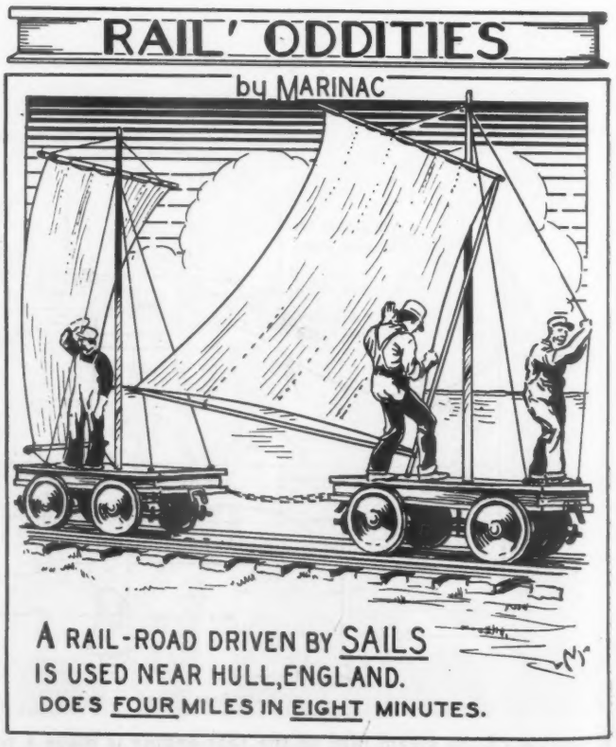
Stress Distribution in Aluminum Connecting Rods

(*Continued from page 96*)

data indicate that when the locomotive was working at about 80 per cent of its rated tractive force the maximum measured stress in the shank section of the main rods was 7,900 lb. per sq. in. The stresses in the main rods, however, were fairly uniform over the entire cross-section. One test indicated a slight tendency of the rod to bend toward the outside. The maximum measured stress in the shank section of the rear intermediate rods was 6,800 lb. per sq. in. This stress was developed when the locomotive was working at about 90 per cent of its rated tractive force. The stress on the inside faces of the rear intermediate rod was about 50 per cent higher than the stresses on the upper and lower edges of the rod, which indicated that the bending stresses were developed in the vertical plane of the rod.

While the grease outlets in these rods are better located than those of the rods from the other Alton & Southern engine, No. 13, previously discussed, yet there would seem to be room for further improvement in the design of the crosshead end of the main rods. In general, the average measured stresses were higher than those computed, which is what might be expected in view of the laboratory tests described. From the stresses measured in the shanks of these rods and the concentration factors found in the laboratory tests, it is believed that a fair estimate can be made at the maximum stresses occurring in the rod under service conditions. This has been done as shown in Table III in the case of the new design of rods for locomotive No. 13.

* * *



Further explanation furnished by the editor upon request

Sidelights on the Union Pacific Streamline Trains*

By A. H. Fetters†

RECENTLY a six car rail train, approximately equal in weight to 100 Cadillac cars, crossed the continent from Los Angeles to New York in 57 hours with a total fuel cost equal to that of one Cadillac making the same trip. To be more specific the main engine used $70 worth of fuel to make this 3,250-mile run. With 124 passengers aboard, the fuel cost per passenger carried is 60 cents as compared with $10 per passenger in the Cadillac. A fair approximation of the cost of fuel for a steam train of five cars and a locomotive would be around $375. While the Diesel engine on this train develops 900 hp., the average power factor for the trip was but 54 per cent.

Having been a designer and builder of the steam locomotive for over 40 years, and with 30 years experience with internal combustion rail motor cars, I cannot help but project this remarkable performance into the future, in imagination, and visualize the future of Diesel rail transportation. I believe its possibilities are very great in economy, speed, cleanliness, reliability, and utilization.

Just 30 years ago the Union Pacific built a rail motor car propelled by a gasoline engine which was the forerunner of the McKeen motor car industry. This was before the day of the electric drive, and mechanical transmissions were used.

Nearly 150 of these cars were built and successfully operated on many roads. Some of these early cars are still in operation with mileage records from one to two million miles.

Then came the era of the gas-electric rail car with its greater flexibility of operation and demonstrated economy over small steam trains in branch line operation.

As early as 1926 your speaker went to Europe to investigate the development of Diesel engines and transmission systems as applied to rail service, but, while many interesting projects were either being tried or suggested, two pertinent facts were apparent. First; that Europeans were mostly experimenting with hydraulic, pneumatic, and mechanical forms of transmission, and second; notwithstanding the advancement of Diesel engine design at that time by such builders as M. A. N. Krupp, Fiat, Burmeister & Wain, Sulzer, Beardsmore, there was no perfected and proved type of Diesel engine having the light weight, flexibility, reliability, and other necessary characteristics for light-weight, high-speed trains, either abroad or at home.

Research in the fall of 1932 disclosed a more fertile field in this respect. Also a progressive railroad, for once, looked over the fences of convention and conviction, into the garden-patch of other and newer industries and, as a result of this research, in May, 1933, an order was placed with Pullman Car & Manufacturing Corporation for a three-car train featuring light-weight aluminum alloy construction, articulation, radical streamlining and powered with a 600 hp. Winton distillate burning, spark-ignition engine, and capable of safe speeds of 90 to 110 m.p.h.

This first train was delivered in February, 1934, and after short break-in runs and a 13,000-mile tour of test and inspection, was placed on exhibition at the Century of Progress. It was also given a series of high speed acceleration and braking tests between Grand Island and Columbus, Nebraska. Quite recently, further tests have been conducted in regard to minor adjustments and resulting in further refinements of performance. The first train has thus been used as a traveling laboratory in order to work out and apply to the following high-speed trains, some details that could only be settled by actual experience in the same manner that new automobile models are sometimes worked out on the proving grounds.

While the balanced speed of this first train is about 90 to 91 m.p.h., speeds of 110 m.p.h. have been recorded during routine test runs, with condition of grade and wind favorable. This three-car train has just been placed in revenue service between Kansas City and Salina, Kansas, making daily round trips of 374 miles. Its service weight is 98 tons.

Last October, the second high-speed train was delivered by the Pullman Car & Manufacturing Corporation. It consists of six cars, including the power car, one mail and baggage car, three Pullman sleepers of novel construction, and the rear buffet coach.

It embraces the same general construction as the first train and weighs 210 tons serviced with fuel, water, etc., but excluding pay load. It is powered, however, with the Winton 900 hp. Diesel engine for propulsion and a Winton 120 hp. auxiliary Diesel engine which generates power for lighting, air conditioning, blower fans, battery charging, and other auxiliaries. After several tuning-up runs, this train was taken to Los Angeles and on October 22, 1934, started its record-breaking coast-to-coast run of 56 hr. 55 min.

Incidentally, this was not an attempt for a speed record, but was for the purpose of checking the proposed 39-hr. schedule from Los Angeles to Chicago, with a continuation to New York City over the New York Central on its Twentieth Century schedule of 18 hours. Had maximum speed been the object of the run, 50 hours appeared feasible.

The best previous transcontinental run was 71 hours from San Francisco to New York in 1906 by the E. H. Harriman Special. The best through schedule at present is 77 hours.

During the test run of the streamliner, fuel was taken en route at Salt Lake City, Cheyenne, Omaha, and Chicago. Through the use of a special electric pump, the fueling rate is 100 gallons per minute, so that fuel stops averaged from 4 to 6 minutes each. The fuel capacity is 800 gallons, and a total of 2,079 gallons of fuel oil was used for both main and auxiliary engines, train heating and cooking, the distance being 3,250 miles, and the fuel rate 1.56 miles per gallon. At 4 cents per gallon this is equivalent to a cost of 2.56 cents per mile.

The highest recorded speed was 120 m.p.h. for a distance of 3 miles, 108 m.p.h. for 18 miles, and 85 m.p.h. for the 506 miles between Cheyenne, Wyo., and Omaha,

* Extracts from a paper presented at the Railway Club of Pittsburgh, Jan. 24, 1935.

† General Mechanical Engineer, Union Pacific System.

Neb., on the Union Pacific, all of which are records for rail speed. The balanced speed of this six-car train is somewhat higher than for the three-car train, approximately 95 m.p.h.

Two additional high-speed trains each having nine revenue cars, and with increased horsepower, are now under construction for the Union Pacific at the Pullman plant and when finished are intended for service, one between Chicago and Los Angeles and one between Chicago and San Francisco. The second, or six-car train, is intended for service between Chicago and Portland, Oregon. Each of these runs is approximately 2,300 miles in length. The schedules will be under 40 hours.

The Influence of Streamlining and Light Weight

That, in brief, is the outline of the high-speed train project at present. Let us now review some reactions that have occurred on other railways and among the builders in the brief time since the Union Pacific trains were first announced.

Proposals for light-weight, high-speed trains, using special forms of streamline steam locomotives, have appeared in print from the Baldwin Locomotive Works, American Locomotive Company, Lima Locomotive Company, and the Bethlehem Steel Company. These proposals all include light weight streamline cars. There seems to be no difference of opinion on that end of it. Among the railways considering these steam proposals are the Milwaukee, which recently ordered two special high-speed steam locomotives from the American Locomotive Company, the Baltimore & Ohio, which has recently finished a special high pressure steam locomotive for one of their announced high-speed, light weight streamline projects.

In the Diesel field we find the Chicago, Burlington & Quincy three-car "Zephyr" following the Union Pacific train; the New Haven aluminum three-car train being built by Goodyear-Zeppelin Corporation; The Illinois Central, which has just placed an order with Pullman Car & Manufacturing Corporation for a five-car articulated streamlined train of 1,200 Diesel hp. for service between Chicago and St. Louis; the Baltimore & Ohio, which will test out an 1,800 hp. Diesel-electric locomotive in high-speed train service, the Santa Fe, which is reported to have purchased a 3,600 hp. Diesel-electric locomotive for experimental service in pulling "The Chief," the Boston & Maine three-car train by the Edw. G. Budd Mfg. Company, powered with a Winton Diesel engine, and the Gulf, Mobile & Northern train by the American Car & Foundry Company.

Streamlining

Streamlining the exterior of fast moving vehicles to reduce power consumption due to air drag is not entirely a recent idea, though much of the art and results are rather recent. Thirty years ago your speaker assisted in designing the first McKeen rail motor car. The body of this car was streamlined to a marked extent even at that period and all subsequent McKeen cars were streamlined. The coming of the wind tunnel and the aerodynamic laboratory has resulted in a vast amount of practical knowledge in the art of streamlining of aircraft, much of which is applicable to our problem. However, there are certain fundamental differences in streamlining a plane, or dirigible in free flight, and a rail vehicle subject at all times to the effect of ground air drag. Streamlining the exterior of fast moving vehicles has recently been receiving serious attention in the automotive field, as well as by railroads. There are a number of recent examples of streamline unit cars and trains, both here and abroad, and wherever it has been scientifically applied it has resulted in satisfaction power reduction at high speeds or has permitted higher speeds with equal power. The application of streamlining is of primary importance when applied to cases where the power supply must be limited, as in oil electric practice. Reduction of air drag, through careful attention to streamlining, was given extended research in connection with designing the exterior shapes of the Union Pacific high speed trains. They were, in a sense, born in the wind tunnel. Preliminary scale models of the first train were tested in the University of Michigan, Ann Arbor, wind tunnel under a competent staff. Much of the work was done at 80- or 90-mile air speed in order to secure data corresponding to running speeds. As the tests progressed it was found necessary to reject some preliminary work as assumptions that applied to testing aircraft models were found to need revision where ratio of length to cross section, the element of ground drag and other elements relative to the train model, were somewhat different from aeronautical work. The work consisted of a series of approximations and occupied several months of intensive research. After all suggested practical refinements in the model had been made, final measurement of the drag in the wind tunnel, and applied to the proposed train, indicated that the train, traveling at 90 m.p.h., would have a total wind drag of approximately 970 lb., therefore requiring 233 rail hp. or 290 b. hp. to take care of the wind factor alone. All mechanical resistances, due to journals, flange, rolling, etc., were estimated by the best available formulas, at approximately 900 lb. at 90 m.p.h. The total calculated resistance was, therefore, approximately 1,870 lb. at 90 m.p.h., which calls for 450 rail hp. or 560 b. hp. These figures have since been closely verified in a series of road tests where electrical output readings were recorded in various runs for several days, while air brake stopping tests were also being recorded. As the maximum engine output is 660 b. hp., of which approximately 600 hp. was available at the generator, the balancing speed is approximately 91 m.p.h. The specification called for a balancing speed of 90 m.p.h.

Air Brake Problems

The problem of arresting 54,000,000 ft.-lb. of energy on the three-car train or 120,000,000 ft-lb. of energy on the six-car train at 90 m.p.h. in the space of 40 seconds, or about half a mile, brings us to the braking requirements of these high-speed trains. To meet the requirements of making stops from speeds of 90 and even 100 m.p.h. within standard distances, it was necessary to develop an entirely new braking system, which has been successfully accomplished by the New York Air Brake Company. The action of the air brake at these higher speeds had not been explored and was largely a matter of conjecture. Heretofore, uniform brake retardation was not possible due to the fact that the coefficient of friction between brake shoe and wheel varies widely with speed and unit pressure, decreasing rapidly at the higher speeds where it is most needed. While this coefficient may be as high as 25 per cent at very low speeds, it fades out to probably 5 per cent or 6 per cent at 100 m.h.p. While very high percentages of braking power are safe at the higher speeds, they would become dangerous as speed decreased and the coefficient of friction between shoe and wheel gradually increased. A point would be reached where the wheels would lock. It would not be safe to trust the judgment of the enginemen to graduate the cylinder pressure down as speed

fell off. In this new brake, in either service or emergency, a very high initial braking percentage is used. The brake cylinder pressure is then automatically controlled, in proportion to speed, by means of a very simple retardation control principle, incorporated in an instrument called a decelekron. This instrument consists essentially of a sliding weight of about 100 lb., sensitively mounted on ball bearing rollers, and arranged to move in the line of motion of the train. It is suitably restrained from initial motion by a calibrated spring and air piston. This weight, acting through suitable leverage to a pneumatic valve, controls the brake cylinder pressure accurately in proportion to the retarding effect. If retardation exceeds the safe degree, the sliding weight automatically reduces the braking effect. This reduction continues until, just before rest, there is just enough air in brake cylinders to stop the train without lurch or jar. In recent road tests with the first train this brake made service stops from 90 m.p.h. in 2,745 ft. This compares with a service stop of 2,500 to 3,000 ft. with the usual steam train brake made from a speed of 60 m.p.h. If we square these speeds for the comparative energy effect of the two trains, the effectiveness of the new brake can be appreciated.

The air brake described is a complete departure from conventional practice, both in its air circuit, and in the design of the valves and parts. The pneumatic feature is based on a two-pipe circuit, consisting of a supervisory line and a control line. The supervisory line distributes air to the reservoir under each car and charges to maximum pressure at all times. In conventional brakes the reservoirs cannot be charged during brake application. The purpose of the control line is to apply or release brakes by admitting air to the pneumatic relay valve under each car, this valve controlling communication between each brake cylinder and its adjacent reservoir, or, from the cylinder to the atmosphere. This control line passes from the engineman's brake valve through the decelekron valve, to each relay valve. This briefly describes the pneumatic action. Parallel to this pneumatic circuit lies an electrical circuit which operates a magnetic control feature in each pneumatic relay valve. This not only synchronizes but accelerates all brake applications and releases. The result is a brake of exceptionally quick and sensitive response, and with it a retardation rate of as high as 3 to 3½ m.p.h. per second is possible.

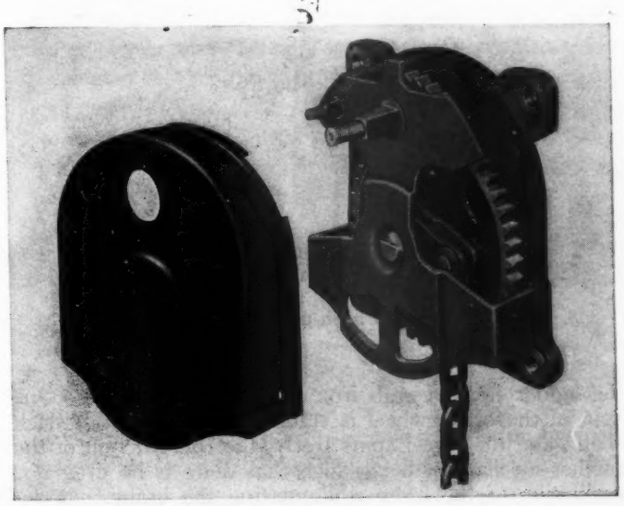
Conclusions

Earlier reference was made to the future developments of the Diesel engine in rail transportation. In concluding this paper attention is directed to one factor now existing that will retard more rapid progress, viz. that in order to cross the continent, as illustrated, with only $70.00 worth of fuel it was necessary to make a large investment in the total power plant, consisting of the Diesel engine and the electrical transmission system. The electric transmission is only 80 per cent efficient at the best power output and the losses may run up to 40 per cent or 50 per cent at times. While the manufacturers have supplied a substantial Diesel engine weighing 20 lb. per b. hp., it is necessary to add 42 lb. per b. hp. for electrical equipment to transmit the engine power to the wheels. Until the manufacturers of electrical equipment can improve power efficiencies and decrease the weight of electrical equipment the Diesel engine will remain under a handicap to which it is not entitled. While the possibilities are remote at this time, some substitute for the electric drive may be ultimately devised. That is a problem that should be receiving the consideration of those principally involved.

High-Power Hand Brake

AN improved vertical-wheel hand brake, known as the Equipco high-power hand brake, has recently been developed and placed on the market by the Equipment Specialties Company, 310 South Michigan Avenue, Chicago. This brake is designed to overcome certain defects and weaknesses which have developed in this particular type of hand brake and to meet the full requirements of modern operating conditions from the point of view of safety, effectiveness and efficiency. Particular features of the new brake include adequate power for one-hand operation; quick take-up of chain slack; safety release lever operation towards, rather than away from, the brakeman; helical winding drum which keeps the brake chain in correct alignment; a housing which is easily removable for the inspection or replacement of parts; standard gear teeth in cast steel gears; and self-lubrication.

The vertical-wheel type of hand-brake construction usually involves the more-or-less permanent enclosure of working parts of the brake in a pressed steel back plate and front cover, riveted together and this assembly riveted, in turn, to the car structure with four large rivets, the latter further holding the back plate and cover together. In order to inspect this brake mechanism or make a replacement it is usually necessary to switch the car to the repair track, cut the four rivets holding the brake to the car, remove the brake unit, cut four or more



Front housing removed to show the rugged casting frame and brake mechanism

housing rivets and completely dismantle the brake. Like any other mechanism, it should be possible to inspect hand-brake mechanism periodically and make minor replacements, if necessary, without taking the brake off the car.

The improved Equipco brake parts, including the pinion, gear, axle, pawl, pawl trip, chain pin, etc., are carried in a rugged cast frame, with a removable pressed steel housing, the latter being used only for protecting the mechanism from the weather and keeping ice, snow and cinders out. The front housing is easily removed by the cutting of two small rivets, after which it can be readily removed, as shown in one of the illustrations.

The gear and pinion in the Equipco brake are provided with standard gear teeth which afford a full contact and

avoid the end thrust common to tapered teeth. Another important improvement is the use of a helical winding drum which lines up the winding path of the drum with the angularity assumed by the brake chain and end rod as the bell crank is swung outwardly when setting the hand brake. This eliminates overstress and strain in the chain links, which is considerable when a chain is being pulled up at an angle to the car end while being wound on a single (vertical) plane winding drum. The Equipco helical winding drum tends to reduce friction and eliminate possibility of breaking chains, an important safety feature.

The Equipco power hand brake can be set or released with one hand, which allows the operator to hold on to

The Equipco high-power hand brake

the ladder or roof-grab iron with the other hand. One spin of the brake wheel is sufficient to take up all slack chain, and the wheel spins freely, the construction of the ratchet mechanism being such that there is no drag nor oscillation of the lever while setting the brake. In releasing the brake, the release lever is pulled towards instead of being pushed from the brakeman, which also contributes to safety. After the brake releases, the release lever stops in a substantially vertical position, providing a safe natural grab handle for the brakeman's right hand. At the time the brake releases, therefore, the brakeman is standing on a firm footing and holds the car structure with his left hand while the fixed release lever is grasped with his right hand.

The Equipco hand brake is unusually light in weight for the power developed, the weight saving being effected without sacrifice of essential strength or rigidity. The brake is bronze-bushed at all important points and the gear hub is provided with a grease pocket which is filled with graphite grease, thus assuring self-lubrication for a considerable period of time. The Equipco hand brake is also manufactured in the horizontal wheel type for all kinds of freight cars and in drop-type brakes for flat cars and drop-end gondolas.

Pitting of Stainless Steel In Naval Applications

DURING recent months rumors have been circulated concerning failures of stainless steels in warships of the U. S. Navy. As is the case many times in engineering experience where applications of new materials are involved conditions unknown and difficult to foresee enter into a problem and bring about undesired results. Railroad mechanical men have an interest in stainless steels and because of the possibility that erroneous conclusions may be drawn as a result of these failures in naval service unless the facts surrounding them are known it is believed that readers of the *Railway Mechanical Engineer* will welcome a reference to an editorial appearing in the current issue of Metal Progress (the monthly magazine of the American Society for Metals) entitled "Pitting of 18-8 in Two Naval Applications" portions of which are quoted herewith:

"The Bureau of Construction and Repair, U. S. Navy, has been interested in corrosion resisting steels ever since their commercial production. Consequently the Navy has put an important tonnage of strip and sheet analyzing 18 per cent chromium, 8 per cent nickel (the so-called 18-8) into deck houses, floors, hatch covers, and a variety of other structures exposed to atmospheric corrosion in port and to dashing spray or water in a seaway. In these places the metal has served excellently, and the Navy has no intention of avoiding such uses in the future. The same may also be said of some other applications of corrosion resistant steel where the metal is submerged almost continuously.

"These satisfactory results encouraged the naval constructors to put corrosion resisting steel into two applications in which unfortunately it did not stand up—namely, gasoline stowage tanks and fire lines. Let us examine the circumstances surrounding such failures.

"Salt water is pumped into the bottom of the tanks so the gasoline can be drawn off under hydraulic pressure at all times; consequently the stowage tanks contain variable quantities of gasoline, doped with tetraethyl lead and ethylene dibromide, and sea water more or less fouled with marine organisms or diluted sewage. Tanks on the first aircraft carriers had been made of galvanized steel plate, welded, with welds tinned—a reasonably satisfactory construction. On the newer ships the tanks were to be built into the hull in quite inaccessible locations, and the use of 18-8 promised absolute immunity from leakage (most dangerous in confined spaces aboard ship!) for the entire life of the hull.

"The second unsatisfactory experience was with fire lines of thin-walled seamless tubing, installed on the latest 10.000-ton cruisers.

"In both situations the stainless steel failed by pitting in as short a time as six months! These two are the applications which have given all the trouble, which are being removed from existing ships, and which will not be resumed until the cause is definitely known and cured. Trouble by pitting apparently exists only in stagnant sea or harbor water, and there is not the least cause for worry about a multitude of applications in dozens of industries where chloride ions, stagnant solutions, and foul deposits are not encountered.

"While the cause and cure of pitting in stagnant sea water has not yet been discovered, the search is vigorous enough to warrant success. If chloride solutions are handled in high chromium steels they should be kept neutral, entirely free from ferric chloride, in continuous circulation, and free from organic or inorganic solids. Periodic cleaning is also quite desirable.

EDITORIALS

Mechanical Associations Conventions

As a result of conferences held in Chicago last September, eight of the railway mechanical associations decided tentatively to hold full membership meetings early in May of this year, with a common exhibit of railway equipment and supplies. Four of the associations planned to hold individual, but simultaneous, meetings on Thursday, Friday and Saturday, May 2-4, and the other four were scheduled to hold similar meetings on Monday, Tuesday and Wednesday of the week following.

While business conditions in general have improved somewhat during the fall and winter, there is still much uncertainty about the future, and this with increased wage and material costs, has prevented the mechanical departments of the railroads from rebuilding their forces and resuming their activities to the extent which had been anticipated. It had been expected also that the Administration would insist that Congress promptly attent to the transportation problem and enact legislation which would remove unfair handicaps from the railroads in competing with other types of carriers. Incidentally, the Association of American Railroads, which succeeded the American Railway Association, has had a busy time organizing its staff and activities to meet the pressing demands which are being made upon it. For these and other reasons no decision has as yet been made by the Association of American Railroads, or its Mechanical Division, as to whether or not the eight mechanical associations mentioned above should meet according to the proposed schedule.

Even if such permission were granted at the present time, it is doubtful whether most of them could arrange programs and set in motion the machinery necessary to insure successful meetings at so early a date. As a matter of fact, because of the uncertainty, most of the associations have made little, if any, effort to arrange programs for such meetings. In some instances, also, the official personnel of the associations has been hard hit by losses incurred during the years in which they have not functioned, and it will be a considerable task to reorganize them and rebuild the membership so that they can function to real advantage.

These mechanical associations have made a large contribution in the past in strengthening the mechanical department and increasing its efficiency. There is a question as to whether, from the standpoint of morale, it might not have been better to encourage them to continue their functions and hold more meetings during the depression period. It will be a distinct loss if they are allowed to remain dormant and fade out of the picture.

In former days, when the promotion and welfare of these organizations depended upon individual initiative on the part of the railroad officers and supervisors, they managed to face all sorts of difficulties with courage and aggressiveness. Since the major mechanical associations have been absorbed by the Mechanical Division of the American Railway Association, and the other mechanical associations have come under its general direction, they have suffered a distinct loss in aggressive leadership, although this may be due partially to the unfavorable economic conditions through which we have been passing.

It is to be hoped that the new Association of American Railroads will recognize the importance and value of these associations and will encourage them to develop strong and virile programs, and to attract into their membership the outstanding men in the mechanical department. Under such circumstances these organizations could continue the splendid work that they did in earlier days and should, indeed, make their efforts even more effective.

Smoke Abatement

It is reported that a railroad smoke association has been formed at Scranton, Pa. This followed a survey of air pollution in that community, which was commented upon in the *Railway Mechanical Engineer* for November, 1934, page 403. Presumably it will be conducted along lines somewhat similar to those followed in Hudson County, N. J., where an unusual record in smoke abatement has been made with the co-operation of a Railroad Smoke Association, which was organized shortly after the Smoke Regulation Department was established in that county four years ago.

The railroads have actively co-operated in smoke abatement programs in a number of cities, although in some instances activities in recent years have not been as marked as they were prior to the depression. In Chicago a Railroad Smoke Abatement Board includes railroad officers, representatives of the brotherhoods and smoke inspectors employed by the railroads. It meets semi-monthly to consider railroad violations and

recommend discipline or other remedial measures. A report of a C. W. A. smoke abatement investigation made in that city during the past winter, indicated "remarkable progress in railroad smoke abatement, resulting from continuous effort over a period of years."

The Smoke Abatement Committee of the City of St. Louis has a railroad section which has functioned for many years. It meets once a month and has a large attendance of engineers and firemen; 166 were registered at the January meeting.

In Cincinnati all railroad smoke problems are handled by the Cincinnati Superintendents Committee, a fuel supervisor having direct charge of the activities.

In Pittsburgh the railroads employ a number of smoke inspectors, who make their reports in duplicate, one going to the railroad and the other to the smoke department of the city. Excellent results are said to be secured there in railroad smoke control.

There may be active railroad smoke movements in other cities and we shall appreciate information from our readers about any of them that may have been overlooked in this brief resumé. The elimination of railroad smoke means much in making friends for the railroads and in reduction of expense because of more efficient use of fuel.

What About Diesel Locomotive Maintenance?

The adaptation of Diesel power to rail service has introduced a variety of problems that are new to railroad men, the greater part of whose experience has been with steam power, and, because this new form of motive power involves an unknown element, many men are somewhat in doubt as to what should be done to assure its successful operation.

Mechanical men are naturally vitally concerned with the cost of operation of motive power and, with the introduction of Diesels, the question of the comparative cost of steam and oil-electric operation has been one of major importance. Those familiar with steam operation feel confident in discussing the costs of steam power because of long experience with it, but when the Diesel-electric is brought into the picture the confidence of experience is lacking and many apparently have a feeling that they are dealing with some mysterious problem that is difficult of solution. Possibly an analysis will help to clarify it.

So far the Diesel engine has been in use in two general classes of railroad service—the light high-speed passenger trains and the heavy slow-speed switching locomotives. In any approach to the question of operating costs these two classes of service must be looked upon as separate and distinct. In the high-speed service the use of Diesel power is still in the initial stage and can not be discussed with the same degree of understanding as is the case with switching service, where the number of installations and the total number of service hours are considerably greater.

Diesel-electric motive power lays claim to several advantages over steam: greater availability for service; lower fuel costs, together with more efficient utilization of fuel; reduction in the cost of facilities required for servicing, and lower maintenance costs. It is handicapped by a distinct disadvantage in the form of considerably higher first cost and high fixed charges.

There seem to be no great differences of opinion among railroad men experienced in Diesel switching operation on the question of availability for service. Here the oil-electric has an average availability of about 88 per cent, as compared with 51 per cent for steam. As to fuel costs, a 600-hp. oil-electric switcher will operate on one-third the expenditure for fuel required for a steam switcher of similar service capabilities. But—and here enters the first of the unknown factors—who knows what the price of Diesel fuel will be as its consumption increases?

A reduction in the cost of servicing facilities can be taken advantage of as the number of Diesel installations increases and as this takes place the railroads will be faced with an increasing amount of unused steam servicing capacity, for as long as steam and Diesels operate together the steam facilities must be maintained.

Finally, there comes the question of maintenance—the real point of contention. Those experienced in steam operation feel that they know what their maintenance costs are. They know that more money is spent for steam locomotive repairs than for any other single account in railroad operation. More than that they know from experience what to do to cut those costs—install modern power, together with modern servicing and repair facilities. But what about the Diesel? Here they are faced with something about which they know very little and, what is more important, there seems to be no avenue of approach to the problem except future experience. It is true that we have had years of experience with Diesels in marine and stationary service. But in these two services engine speeds and conditions of operation can not be compared to railway service, so the answer is not to be found in that direction.

The maintenance problem of a Diesel-electric locomotive is readily divided into three distinct parts—the mechanical and the electrical equipment maintenance, with both of which the railroads have had years of experience, and the Diesel engine maintenance, which is really the only unknown factor. In switching service Diesel engines are working most of the time at from 10 to 20 per cent of their rated horsepower, as compared with 70 to 80 per cent in high-speed passenger-train service and this fact will naturally have some influence—to what extent is unknown—on the cost of engine maintenance. Eight years of Diesel-electric switching experience have, however, given us some cost figures to play with—figures which indicate that the repair costs on 300- to 400-hp. locomotives will range

from $0.62 to $1.38 an hour and on the 600-hp. locomotives, from $1.15 to $2.23 an hour. These costs include mechanical, electrical and Diesel-engine maintenance probably in the proportion of about 48 per cent for the Diesel engine, 24 per cent for electrical equipment and 28 per cent for mechanical equipment.

What of these costs as compared with steam? At an average of $1.09 an hour for the repair costs of approximately seventy 300- and 600-hp. locomotives and an average switching speed of 6 m.p.h., the cost to be compared with steam is 18 cents a mile. Is this cost high in view of 88 per cent availability for the Diesel as compared with 51 per cent for steam? This comparison is one of switching service only.

Any extension of these comparisons into the realm of road service immediately injects the unknown factors of the influence of the increase in locomotive horsepower, or the increase in load factor on these maintenance costs. Furthermore, any comparison of steam and Diesel in road service must be made on the basis of equal horsepower capacity.

Take the Public Into Your Confidence

Streamlining! Diesels! High Speed! These are the things which have served more than anything else in the past year to stir up the imagination of the public and re-create an interest in railroads. There are many in the railroad industry who have lost faith in the future of that industry without realizing that the public, upon whom the railroads must rely for success, is still intensely interested in what is going on. This can not be denied when one looks back on the acclaim that was accorded the Burlington "Zephyr" when it was first introduced and upon the fact that thousands were sufficiently interested in the transcontinental run of the Union Pacific train to line the tracks almost from coast to coast and wait for hours to get a glimpse of this new thing in railroading as it sped by on its way to a new record. You, as a railroad man, may say that this was because these were new developments; that the public is not interested in railroads except when they do something spectacular. You may even go so far as to say that the day of the old steam locomotive is all done and that the future points to a new form of power which will make obsolete all that we now have. Those who have spent at least 20 years of their lives around a railroad will recall the period when it was predicted that electrification would supplant steam power but we can now review history and see that electrification was an important step in the march of progress and that it has found its place and filled a definite specialized need in railroad operation, but that it is not a panacea for the solution of all the operating problems of all the railways.

Not long ago the Lackawanna exhibited one of its new modern steam locomotives at points along its line and the public turned out in numbers to view this latest example of the builder's art. During the week after Christmas the New York Central ran the streamlined "Commodore Vanderbilt" into the Grand Central Terminal just to see if the public was still interested in a steam locomotive. Were they? The answer is recorded in the fact that upon two of the coldest days New York had in the month of December 47,000 persons were interested enough to visit the exhibit; 29,000 of them were interested enough to walk through the cab and ask questions about the many devices that are used to control speed with safety.

There have been enough incidents of this kind during the past year to convince the railroad man that the public is interested in his business and that if he will renew his faith in the future of the industry and strive to give people what they want they will reciprocate with their patronage. If the railroads can be criticized for any one thing it is that they have kept hidden from the public the things people want to see. Now they have had a taste of the popular acclaim which comes as a result of a job well done in developing something new plus a bit of showmanship in presenting it. This may be an appropriate time to ask whether the automobile industry has profited by taking the public behind the scenes and making it easy for people to see what makes the wheels go 'round. How many railroad men have gone to an automobile plant and asked permission to see how their favorite car is made? Were they told that it was against the rules or that they would have to have a letter from some officer of the company in order to get in? No. They were probably given a courteous, intelligent guide who did his best to make the visitor feel that he was looked upon as a valued customer.

Now that railroad men know that the public is interested in railroads it may not be out of place to mention that it might be worth while to take a lesson from the automotive industry and take the public in behind the scenes of railroading—the enginehouse and the shop—and show them the scrupulous care that is taken to make sure that the modern locomotive is the safest thing on wheels behind which to ride.

NEW BOOKS

HANDBOOK OF INDUSTRIAL FABRICS. *By George B. Haven, Massachusetts Institute of Technology. Published by Wellington Sears Company, New York. 538 pages, 5½ in. by 8 in., illustrated. Bound in leather. Price, $2.*

A large amount of condensed data has been assembled in this book of six chapters and 52 tables. The book takes up raw materials, manufacturing processes and uses of various cotton and mechanical fabrics. Other sections cover specifications, laboratory practices, definitions and bibliography and closes with a complete index.

With the

Car Foremen and Inspectors

Freight-Car Reconditioning On the Illinois Central

Concentration of heavy freight-car repairs at the major points makes possible the installation of adequate facilities for systematically handling the work

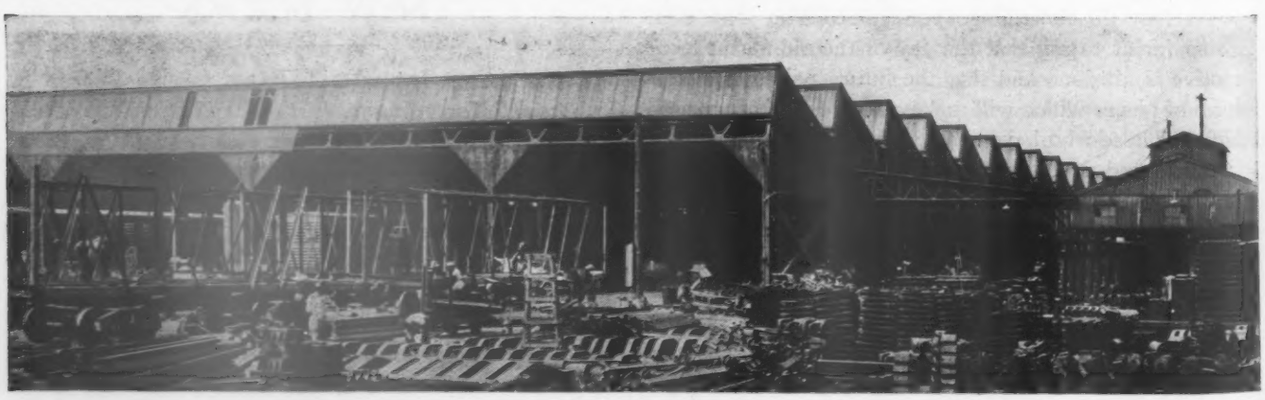
EXTENSIVE freight-car repair and reconditioning work was carried on by the Illinois Central during 1934, the work being done largely between the months of April and October and financed by loans from the Public Works Administration. A total of 12,645 cars were repaired, by far a great majority of the repair work being concentrated in well-equipped shops at three major points as follows: Centralia, Ill., 3,201 cars; Nonconnah (Memphis), Tenn., 4,518 cars; McComb, Miss., 3,532 cars. Most of the box-car work was concentrated at McComb, where a repair shop organization, labor-saving equipment and material-delivery system were provided to handle this work on a highly efficient basis. The repair shop at Nonconnah, also fully organized and equipped, handled a considerable number of box cars, but specialized on composite gondolas and stock cars. Steel hopper-car work was concentrated at Centralia, where an efficient organization and necessary special facilities were provided for making repairs to steel cars. This shop, however, also turned out 1,518 composite gondolas and 713 automobile box cars, some of which were equipped with a mechanical loading device.

The general method of handling heavy car repairs on the Illinois Central is well illustrated by the procedure at the Centralia shops. At this point, a car-repair shed, 88 ft. wide by 500 ft. long, is located in a general north-and-south direction, being served by the customary machine shop, blacksmith shop, paint shop, tool room, air-brake room, wood mill and stores department, these various facilities being located as shown in the drawing. The car shed, itself, contains four tracks, namely, No. 5 to No. 8, inclusive, on which various classes of repair work are segregated. Just south of the car shed is a stationary bridge-type crane served by an electric monorail hoist which has cross movement over two tracks and proves a great labor saver in handling car sides, sills, truck bolsters, and other heavy parts.

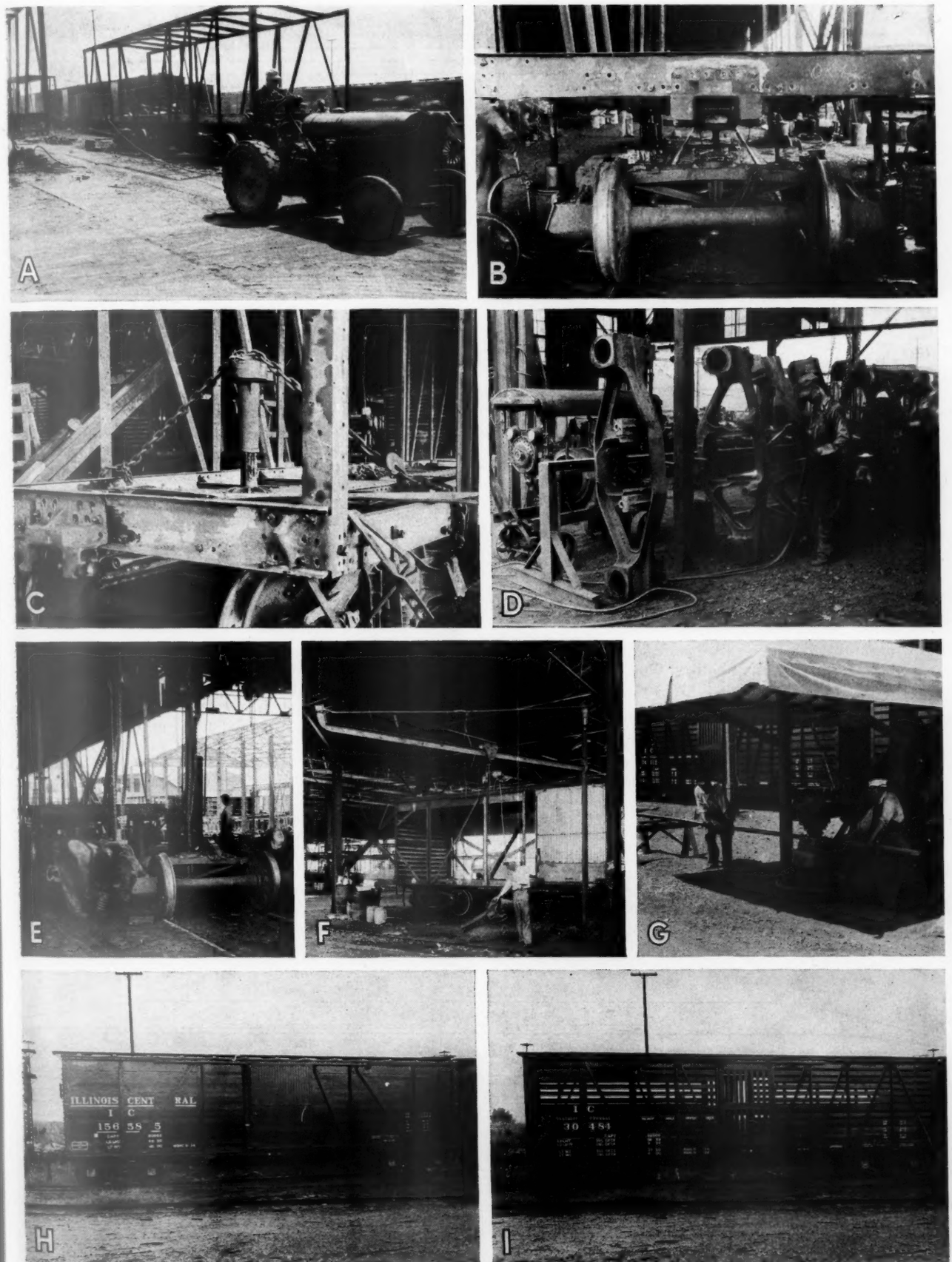
The car shed, which is open on the sides and ends, is well lighted and equipped with ample air and acetylene gas connections. Pneumatic jacks are provided for use in removing and reapplying car trucks, draft gears and other heavy parts. Modern low-pressure rivet heating forges are installed. One of the greatest single labor-saving devices in the shop is the Hanna pinchbug riveter, illustrated, which not only saves time and labor in driving rivets but holds the sheets firmly together during the riveting operation and drives a tighter rivet than can be done by hand. Moreover, considerable "set-up" time, required with hand riveting, is saved, since the steel sheets are automatically held together under heavy pressure during the riveting operation.

In repairing solid-bottom gondolas, Illinois Central series No. 107,000 to 108,499, at Centralia, the cars are brought to the stripping Track 12, the wood being removed first. The cars move up to the metal position, where all defective metal parts are removed by the use of the acetylene torch and rivet busters. The capacity of this track is about 25 cars. After cars are stripped, they are moved northward and switched back to Track 6, along which they move into the car shed.

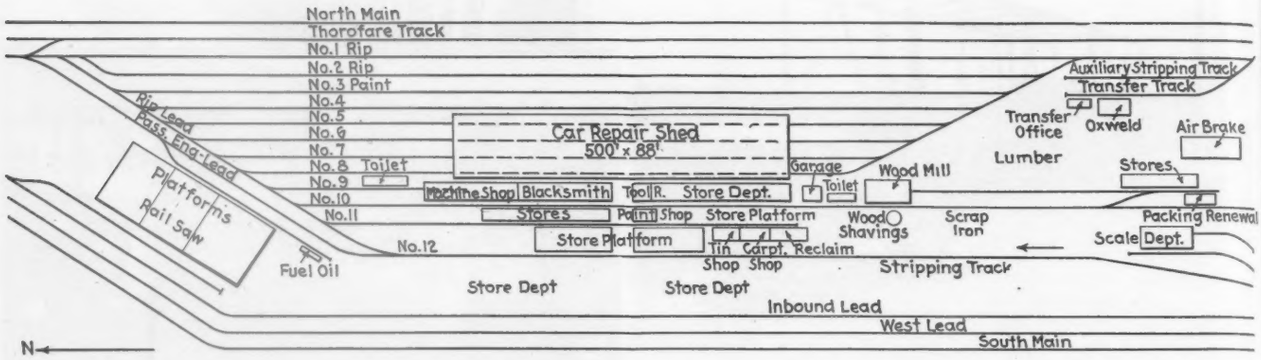
The work on these cars is done in orderly sequence as the cars move through the shop, as follows: Operation 1, car cleaned and dope removed from journal boxes;



General view from the east end of the Illinois Central freight-car shops at Nonconnah (Memphis), Tenn.



Various operations in the repair of freight cars at Nonconnah shops: (a) McCormick-Deering tractor used in moving cars; (b) air cylinders used in jacking cars—draft gear application plunger in center foreground; (c) straightening bolster and transom plate; (d) welding worn side frame bearing surfaces; (e) arrangement of three chain falls for dismantling and reassembling truck bolsters and side frames; (f) 25-ft. gib crane with a ½-ton electric hoist; (g) Bradley hammer used in straightening angle iron; (h) finished box cars; (i) typical stock car ready for service



General arrangement of Illinois Central freight-car repair facilities at Nonconnah

Operation 2, car jacked and trucks moved back to facilitate the application of body bolsters and draft lugs, necessary welding and straightening of the center sill performed; Operation 3, all underframe parts fitted up and assembled ("No-ox-id filler red" applied to metal contact points before fitting up); Operation 4, all superstructure parts fitted up and assembled; Operations 5 and 6, holes reamed and fitting up completed; Operation 7, underframe riveted, using both air hammers and the pinchbug riveter; Operation 8, superstructure riveted and nail ties applied to underframe, one coat of car cement applied; Operation 9, car jacked, trucks removed and thoroughly overhauled, paper applied to the top of metal parts of the underframe, draft gear applied, all loose rivets renewed, brake cylinder and piping applied; Operation 10, decking applied and air brakes tested; Operation 11, decking nailed and siding placed on the car; Operation 12, siding bolted; Operation 13, couplers and safety appliances applied and the car thoroughly inspected; Operation 14, car painted.

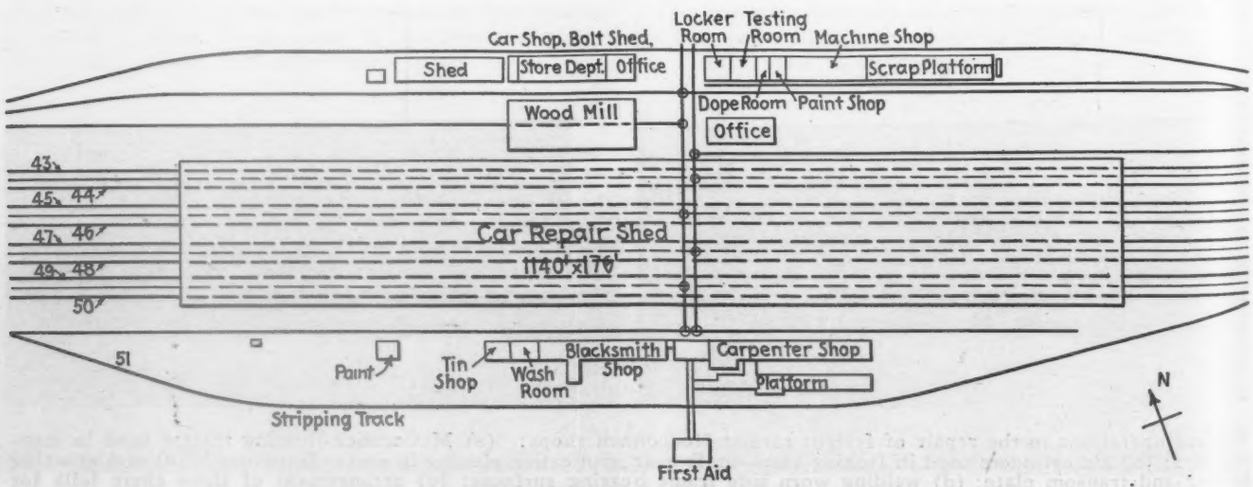
After the car leaves the last position, it moves down approximately 20 car lengths and is given a second coating of paint, then being switched north on Track 3 where it is stenciled, ready for weighing and movement to the transportation yard.

Fourteen positions are also required in the repairing of the I. C. No. 161,000 series automobile box cars at Centralia, these cars being thoroughly overhauled, new siding and floors applied, doors widened, roof removed, rechecked, repaired and relaid. In the repair operation, the cars move to the auxiliary stripping track south of the shop where all wood is removed. The cars are switched northward and enter the north end of the shop on Track 8. On this track, which is a stub track north of the car shed, all electric welding which would in any way interfere with the progressive movement of the cars is performed. After this is done, the cars are backed out of this track and placed on Track 7 where the various repair operations are completed.

Illinois Central steel hopper cars received at Centralia for heavy repairs are switched to Track 4 where all necessary stripping and repair work is done. Subsequent work on these cars is conducted by the progressive method at 11 positions, as follows: Operation 1, cars cleaned of rust, journal-box packing removed; Operation 2, cars stripped and defective parts sent to the blacksmith or reclamation shop for necessary reconditioning; Operation 3, parts assembled; Operation 4, holes reamed; Operation 5, necessary straightening and welding done; Operation 6, draft lugs riveted; Operation 7, all other parts riveted; Operation 8, trucks thoroughly overhauled and draft gear applied; Operation 9, air brakes cleaned, tested, and necessary piping renewed; Operation 10, couplers applied and dump doors adjusted; Operation 11, car painted.

Cars repaired at Centralia shops move off Tracks 4, 6 and 7 in a southward direction, finally meeting at X, this arrangement permitting the day's run of cars to be taken care of without using a switch engine. After the cars are painted they are moved back through Track 3 as previously stated. The delivery of the material is handled by the stores department on orders from the mechanical department by the use of gasoline tractors and a side-car motorcycle.

The car-repair shed at Nonconnah is 176 ft. wide by 1,140 ft. long, of the open side and end type, being pro-



General arrangement of Illinois Central freight-car repair facilities at Centralia

Miscellaneous views taken at Centralia shops: (A) Stationary bridge-type crane and electric mono-rail hoist installed just south of the car shed; (B) stripped center-sill in the foreground and view of completed automobile box cars in the background; (C) Hanna pinchbug riveter as used in riveting steel car frames; (D) automobile box car and low-side gondola just coming out of the shop

vided with 8 standard-gage tracks for the accommodation of cars undergoing repairs and 4 intermediate tracks to serve for the delivery of material. The usual shop facilities are provided in conjunction with this car-repair shed. Cars are moved about the shop by means of a McCormick gasoline tractor shown in one of the illustrations. Portable air cylinders are used in jacking cars and a cylinder set between the tracks beneath the shop floor serves for removing and especially re-applying draft gears much more easily and safely than can be done by hand alone. The stroke of the air cylinder for applying draft gears is 8 in. The stroke for use in jacking the cars is 14 to 16 in. The cars are jacked up, one end at a time, all the way, but, as a safety precaution, two drops are employed coming down, using blocks on the side bearings.

Another illustration shows the three chain falls used in assembling or disassembling trucks, bolsters and side frames with a minimum of hand labor and with little danger of marring the journals. The method of using a 50-ton Duff jack in straightening transom plates is shown in one of the illustrations.

Still another labor-saving device in the shop is the gib crane, illustrated, which is of light but strong construction and equipped with a ½-ton electric hoist which greatly facilitates handling all sorts of heavy materials. One of the most extensive uses for this device in connection with gondola car work is in the application of the drop doors. This crane, with a 25-ft. swinging boom, covers the entire car and serves two tracks.

An effective method of straightening angle iron and similar sections has been developed, using a Bradley hammer installed under a suitable protective canopy outside the car shed. This hammer is equipped with electric-motor V-belt drive and can be used for straightening angle irons and steel shapes without heating.

The shop is equipped with oxygen and acetylene gas for the various cutting and welding operations. Electric welding facilities are also provided for use where needed. One of the illustrations shows the arrangement for use in welding truck sides which are placed on end, leaning against a substantial steel rail so arranged as to hold the truck sides in position for most convenient welding. The operation shown consists of building up the side bearings. In cases where the bearing surfaces are badly worn, wear plates are applied by the electric welding process to minimize the amount of electric welding required. Coupler heads are burned out, using the oxy-acetylene torch and reclaimed using the electric-welding process to apply a tempered wear plate.

The capacity of the stripping Track 51 at Nonconnah shop is 32 cars, all-wood and some steel cars being handled here. The cars are then moved to the respective progressive tracks as they enter the east end of the shed. After passing through the shop, they are given three coats of paint on all new work and switched to Track 50 where they are stenciled and receive the final inspection. When this is completed, they pass on out of the east end of the shed and are weighed and stenciled ready for the train yard.

A day's run of repaired cars at Nonconnah comprises 18 box cars and 10 stock cars, or 28 cars a day. Tracks 43 and 44 in the shed are devoted to stock cars. On these two tracks, just east of the car-repair shed, there are nine positions for work, as follows: Operation 1, cut off steel with acetylene torch, remove journal packing; Operation 2, cut off steel and remove from car; Operation 3, remove draft gear and couplers; Operation 4, cut off underframe rivets with rivet busters; Operation 5, clean rust off underframe; Operation 6, apply new steel to underframe; Operation 7, apply new side and end sills; Operation 8, fit up draft arms and draft lugs; Operation 9, rivet draft arms, draft lugs and bolster cover sheets.

The cars then move on Tracks 43 and 44 into the east half of the shed where the work is handled as follows: Operation 10, repair trucks and apply draft gears and couplers; Operation 11, fit up stakes, braces, posts and air brakes; Operation 12, fit up top side plates, end plates and air brakes; Operation 13, fit up carlines, door frames and square car; Operation 14, ream underframe; Operation 15, rivet underframe; Operation 16, ream top side plate and end plate.

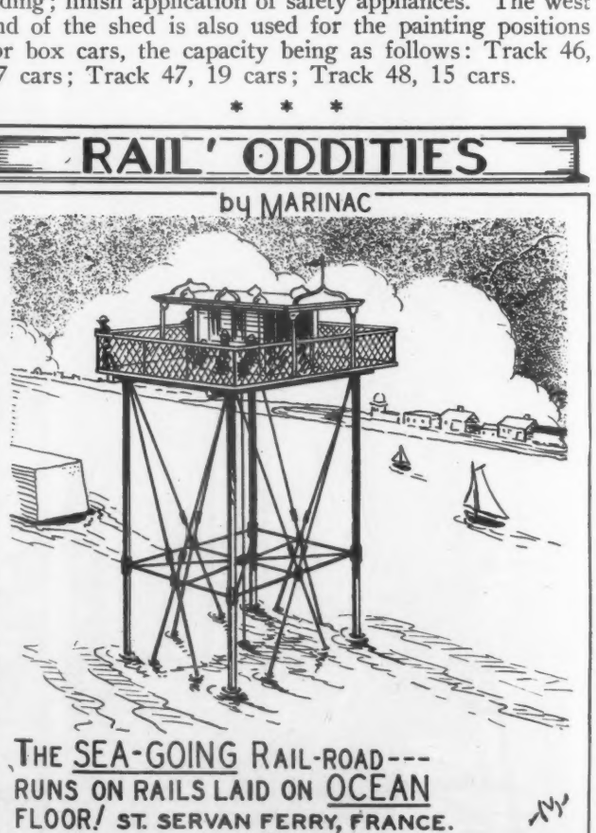
In the west end of the shed, the operations include: Operation 17, rivet top of car side and end plate; Operation 18, apply nailing stringers, sill cover paper and car cement; Operation 19, apply decking; Operation 20, apply ridge pole and purlines; Operation 21, apply end lining and wood ends; Operation 22, apply siding; Operation 23, apply roof and running board; Operation 24, apply cattle bars, side doors, fixtures and safety appliances. The west end of the shed holds 8 cars on Track 43 and 10 cars on Track 44. Paint is applied here, the cars then being switched to Track 50, as stated.

Box-car repairs are handled on Tracks 45, 46 and 47, the same general method being used, with operations as follows: Remove journal packing; cut off steel with torch; clean underframe and remove rust; tighten roof; remove draft gear and couplers; repair trucks, apply draft gears and couplers; weld door track extensions and do air work; fit up steel work and ream; weld side-plate extensions; apply side doors; apply door fixtures; rivet all parts; apply sill cover paper and car cement; apply decking; apply running-board saddles; apply running board and end lining; apply wood door posts; set in place and brace car siding; drill holes and bolt car siding; finish application of safety appliances. The west end of the shed is also used for the painting positions for box cars, the capacity being as follows: Track 46, 17 cars; Track 47, 19 cars; Track 48, 15 cars.

* * *

RAIL ODDITIES

by MARINAC



Further explanation furnished by the editor upon request

Color in Passenger Cars

*By R. H. Hookway**

COLOR is one of the most important considerations in the finishing of a railway train and applies to the exterior as well as the interior.

Particularly for the exteriors of the new streamline trains, bright, clear colors are used, and are placed or distributed in a manner to create something of an impression of speed and to enhance the streamline effect. For instance, window recesses present something of a problem in that they break up the streamline. A very simple, but effective, solution to the problem is a horizontal color band the width of the windows running the length of the train which, of course, ties all the windows together in one unbroken line. This band of color, while it can be strong and clear, should be comparatively dark in contrast to the main body color.

In general, it may be said that the design or form in which color is applied to the exterior of a streamline train should in no way seek to change the lines or form, or to produce an ornamental effect. It should follow and enhance the streamlines and help build up the interest in the simple, smooth form of the surface, rather than detract from it by an overabundance of ornament in the way of striping and lettering. This means that those colors should be used which are appealing and attractive in themselves and do not depend for their interest on ornamentation and contrast with other colors.

Railways have been quick to take advantage of the very widespread interest in modern color effects and have turned to enamel finishes for interiors to replace the grained wood over metal finish that has, heretofore, been so universally used. Air conditioning has not only created a new atmosphere and comfort in a railway car, but has also stimulated the appeal of light, "airy" colors as against the old, dark, heavy effects of the grained walnut and mahogany wood finishes. What are commonly referred to as pastel tints and shades are very popular and although rather pure and bright colors are used, considerable restraint should be exercised in not introducing too many different colors into the scheme. As a general rule, it is best to use colors of the same family, or the same color in different values for the divisions of ceiling and wall space. For instance, a pastel shade of autumn brown for the wall up to the window sill, the wall above that in a lighter shade of the same color, a lighter tint again for the extreme upper wall and then just a very delicate tint for the ceiling. Darker and stronger accent colors can be used on small areas such as the window sill, narrow window sash, narrow molding just above the windows, etc.

Indirect lighting in the modern car makes it advisable to use a very light ceiling or headlining color. In most cases, this color should have very nearly the light reflecting value of white. It will be found that reflection of color from the wall to the illuminated ceiling will be sufficient to tone in the color value with the walls so that the contrast of light and dark will not be too sharp. A simple and safe rule is to add just a slight amount of the lightest wall color to white for the ceiling, the resultant tint being just right to absorb color reflection from the wall, thereby producing the desirable soft harmony of color and values.

If the ceiling color is at all deep, it will be found impractical to use enough lights to obtain efficient illumination and if the gloss is too high, reflection of the lighting fixtures and bulbs will be visible, due to the finish acting as a mirror. Also, undesirable shadows will be cast on the surface because of the slight irregularities of the surface. The finish must, however, have enough sheen or gloss so as not to attract and retain dust readily. This is more important than might be realized on first thought, because while air conditioning makes for a clean interior, still whatever dust there is in the car will follow the direction of the air and has a tendency to settle in streaks. A dead flat finish not only attracts the dust, but is not as easily cleaned as a finish with some amount of sheen or gloss. In other words, there must be some compromise between the ideal light reflecting value of a dead flat finish and the practical considerations of a semi-gloss finish.

Applied ornament in the way of elaborate scroll work and striping is conspicuous by its almost total absence. However, in modernizing the color scheme of an old style railway coach, due consideration should be given the architectural lines and some ornament, such as striping in soft colors and trimming of moldings around panels is not only permissible, but really necessary to preserve the interest in the basic design of the interior. For instance, ornamental cornices, panels, pilasters, etc., need not be so conspicuous as heretofore, but neither should they be disregarded and an attempt made to paint them out. They can be treated with a soft contrast of color and with just enough trimming or striping to preserve the design without overemphasizing it.

* The author is associated with The Sherwin-Williams Company's decorative studios.

Medart Compensating Car Axle Drive

A COMPENSATING drive, recently developed by the Medart Company, St. Louis, Mo., transmits power from the car axle to driven units, such as lighting generators, air-conditioning generators, compressors, etc. This drive was designed to produce a constant flow of power, without belt slippage; to overcome misalinement of the axle and driven shafts; to secure the flexibility of an endless belt drive; to permit of ease in installation; and to be readily accessible for maintenance.

Reference to the drawing shows that the generator sheave *B* is of the solid V-sheave type, grooved for the required number of belts. For generator sheaves delivering full load at about 30 m.p.h. car speed, with an axle-sheave to driven-sheave ratio of 2.2 to 1, the following represents good practice: 5 kw., 6-in.-wide sheaves, 4 belts; 10 kw., 8-in.-wide sheaves, 7 belts; 15 kw., 10½-in.-wide sheaves, 9 belts; 20 kw., 14-in.-wide sheaves, 12 belts. Tension is produced in the belts by means of the usual generator compression spring *F*. Tensions required for the various capacities are approximately 500 lb. for 5 kw., 800 lb. for 10 kw., 1,000 lb. for 15 kw., and 1,300 lb. for 20 kw.

The car axle sheave *A* is a flat, straight faced, flanged, split cast steel sheave bushed to fit the axle. The face width is sufficient for the lateral belt action caused by axle journal wear and by misalinement. The compensator unit *C* consists of the following parts: Two V-sheaves, yoke, king pin, housing and unit support.

The idler sheaves which are roller bearing equipped, are mounted on horizontal shafts. The yoke is the supporting member of the housings, and incorporates a roller bearing equipped king pin. The housings, bolted to the yoke, provide support for the sheave shafts and

give rigidity to the compensator unit in a vertical plane longitudinally. The cast steel unit support provides complete compensator unit support through the king pin, and is bolted to the car truck frame. Alemite lubrication is provided.

The V-belts *D*, in required quantity for capacity, are endless and of small cross section, with strength members concentrated on the neutral axis which reduces internal friction to a minimum. To permit insertion of the belts the end cross piece of the truck is cut out. After the endless belts are installed this opening is bridged by splice members *E* which are furnished with necessary bolts.

Referring to the drawing, the V-belts *D* contact the flat face axle-drive pulley or sheave *A* with their widest face, then travel around the V-grooved idler sheaves and then around the V-grooved driven generator sheave *B*, and back over the second idler sheave, completing the circuit.

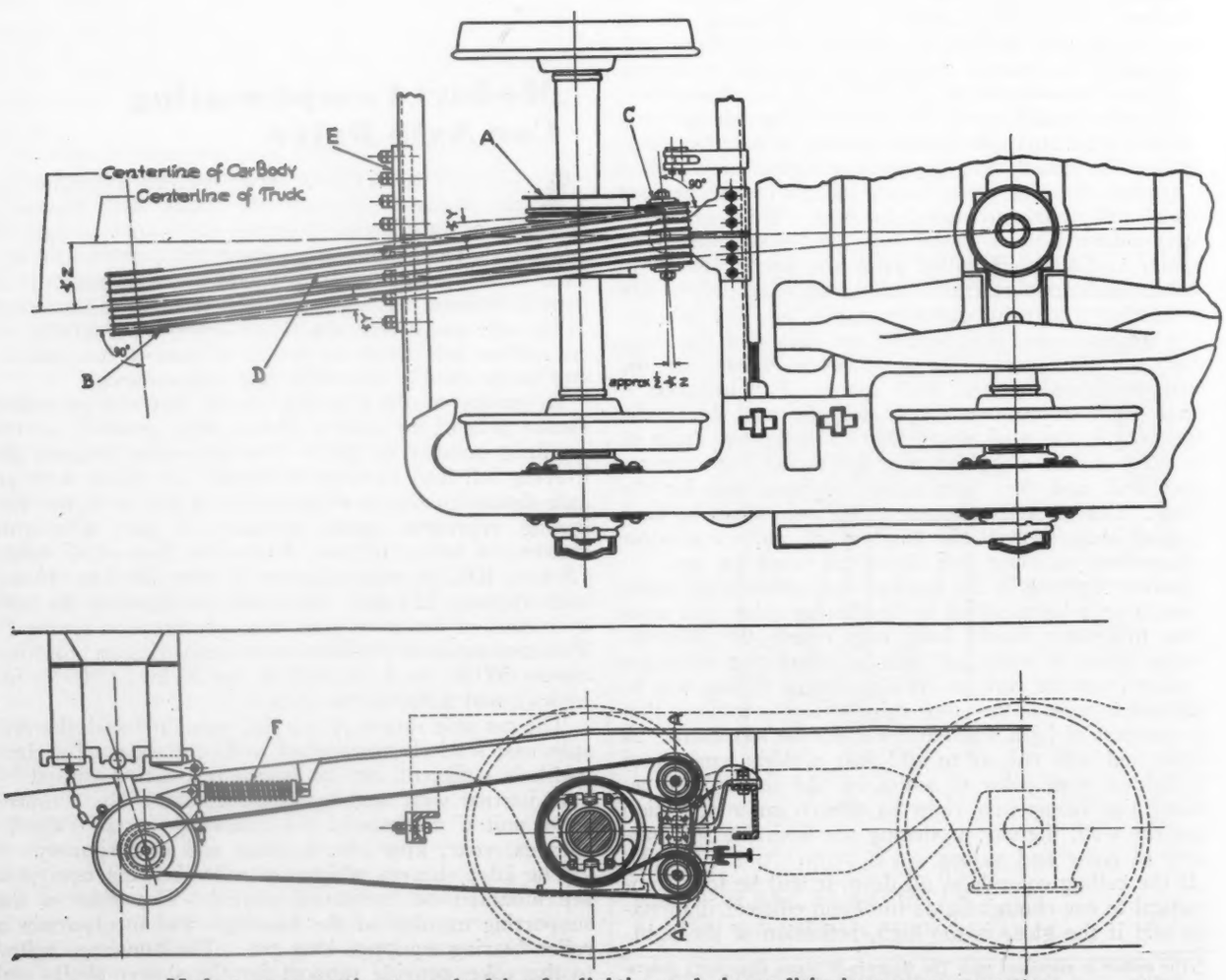
The compensator unit *C*, directly behind the axle pulley *A*, compensates for misalinement and equalizes the belt tension when the axle is not parallel with the generator pulley, as occasioned by the swiveling of the truck at track curves, etc. This is accomplished because the compensator unit *C* is free to swivel around its vertical king pin. When the car rounds a curve and the truck frame changes its relative position to the car body, a misalinement occurs similar to that shown on the drawing. The angle of misalinement *Z* requires the compensator unit to swivel in the same direction of misalinement to approximately bisect the misalinement angle. This action occurs when the misalinement is in either direction. The compensating action is very sensitive, as the king pin bearings are of the anti-friction type.

The compensating action provides equal tension in all belts at all times, thereby insuring equal load distribution. The fleeting angle *Y* is the angle between the center lines of the V-grooves and V-belts, and is present when the car truck is in misalinement with the center line of the car. This fleeting angle *Y* remains constant for a given car-truck misalinement regardless of the capacity of the drive.

The axle end play is not interfered with because the belts are free to shift laterally across the face of the flat faced pulley.

Inclement weather conditions are said to have but little effect on the efficient operation of this drive as all contact surfaces are fairly well protected and are greater than 180 deg. of the total circumference, except on the generator sheave.

Advantages claimed for the Medart compensating car axle drive include: Equalized belt tension at all times; noiseless operation; simple mechanical construction; easy application; easy belt replacement by the use of common shop tools and without wheel jack-up; smooth, non-pulsating and shock absorbing; endless belts; large capacity capabilities; overload protection; economical operation; long belt life, with low cost per car-mile; Alemite lubrication.



Medart compensating car axle drive for lighting and air-conditioning power generators

In the Back Shop and Enginehouse

The distributing and brake valve section along the south side of the shop

Pennsylvania Air Brake Shop at Pitcairn, Pa.

THE major portion of the repair work on air-brake equipment, injectors, headlight generators, fire doors, pneumatic fire doors and train-control equipment has been concentrated by the Pennsylvania at four principal repair shops—Fort Wayne, Ind.; Pitcairn, Pa.; Altoona, Pa., and Wilmington, Del. The Pitcairn air-brake repair shop handles practically all of the repair work on this type of locomotive and car equipment for the Central Region of the Pennsylvania, which takes in the territory from Altoona, Pa., to Columbus, Ohio, including the Cleveland, Erie, Buffalo and Rochester districts.

The Pennsylvania has established a policy in maintenance work on equipment of this type whereby no repairs and, in many cases, no adjustments are permitted to be made to equipment at outlying points, defective parts being removed from locomotives or cars and replaced with repaired parts taken from stock. The storekeepers at outlying points in the Central Region draw weekly upon the Pitcairn air-brake repair shop for repaired units to be placed in stock at their respective points. Some idea of the general nature of the work performed at Pitcairn may be drawn from the list of equipment shown in Table 1. One of the illustrations shows a portion of one of three sheets of the form used by the storekeepers at outlying points in requesting repaired units from a central repair point. The three sheets of this form contain over 200 items of equipment which are repaired at shops like Pitcairn.

Under present conditions this department of the Pitcairn shop, with a force of approximately 125 men, turns out the following approximate quantities of repaired units each month:

750	pump governors
1,000	C6 feed valves
2,200	K2 triple valves
2,000	1¼-in. angle cocks
7,000	1¾-in. air-brake hose
700	steam hose
700	globe and angle valves
600	air and steam gages
800	water gages
500	injectors
50	lubricators

The above list does not by any means include the quan-

From the east end of the shop—hose repair section in left foreground, distributing and brake valves at left and triple valve section at the right

tities of all of the many hundreds of items which are turned out of this shop, but is included to give a general idea of the number of some of the principal items which are handled under present conditions.

Description of Shop

Practically all of the work on the type of equipment mentioned is handled at Pitcairn in a well-equipped shop housed in a building 72 ft. by 238 ft., the general arrangement of which is shown in one of the drawings accompanying this article. At the west end of the shop is located the gage repair section, the injector repair section and the air pump repair section. Adjacent to the injector and gage repair sections on the north side of the shop is the electrical equipment repair section, handling repair work on train-control and cab-signal equipment and headlight generators. Along the south wall of the shop are located the sections where feed valves, brake valves and distributing valves are repaired, and at the southeast corner of the shop is the hose repair section. In the northeast corner of the shop adjacent to the shop office is a section devoted to the repair of pneumatic tools and in the center of the shop is located the angle cock and triple repair and cleaning section.

Table I—Typical Locomotive and Car Parts Repaired at Pitcairn Shop

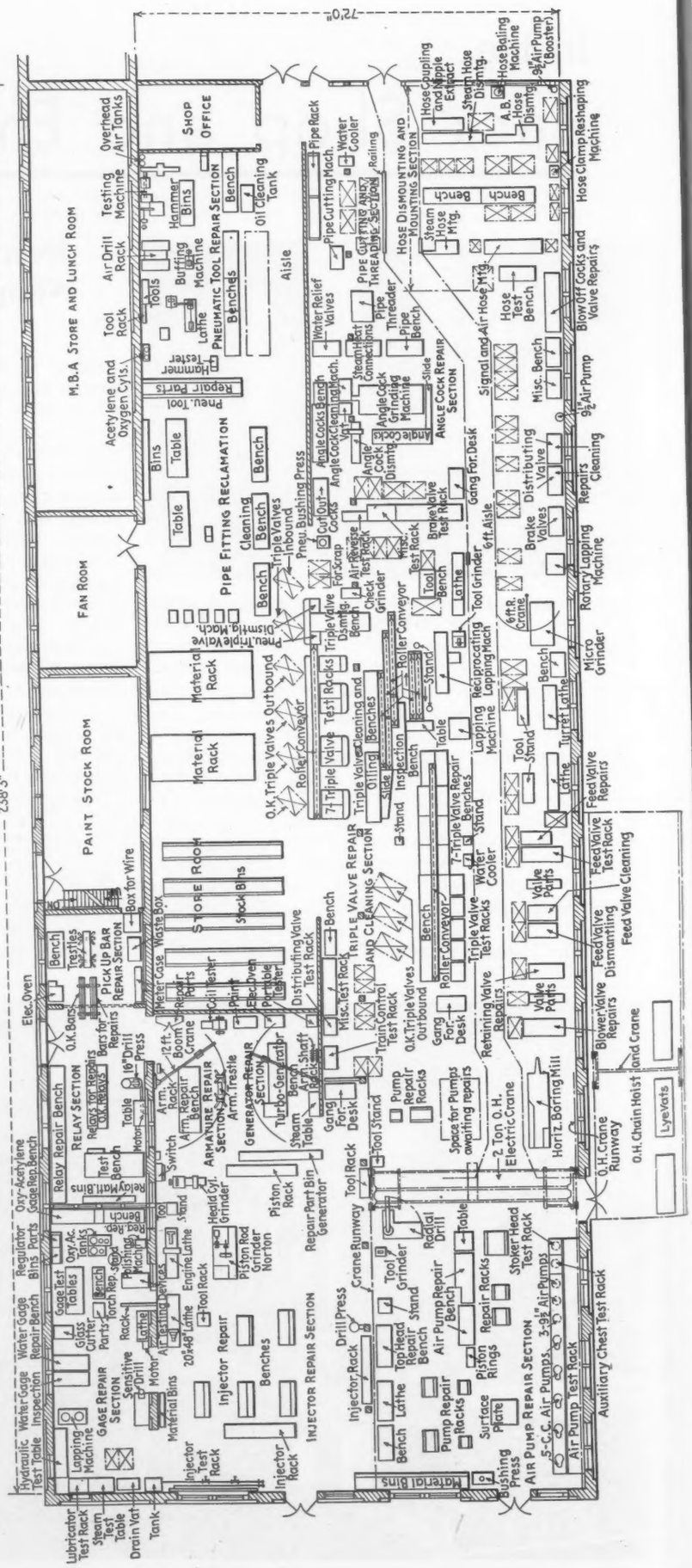
Air-brake apparatus:
- Distributing valves
- Triple valves
- Reducing valves
- Brake valves
- Conductors valves
- Retaining valves
- Safety valves
- Feed valves
- Cut-out cocks
- Whistles, Signal
- Strainers
- Dirt collectors
- Pumps, Air, 9½ in.
- Pumps, Air, 8½ in. c.c.
- Angle cocks
- Air hose, Train line
- Air hose, Signal
- Air compressor cocks
- Gage, Air

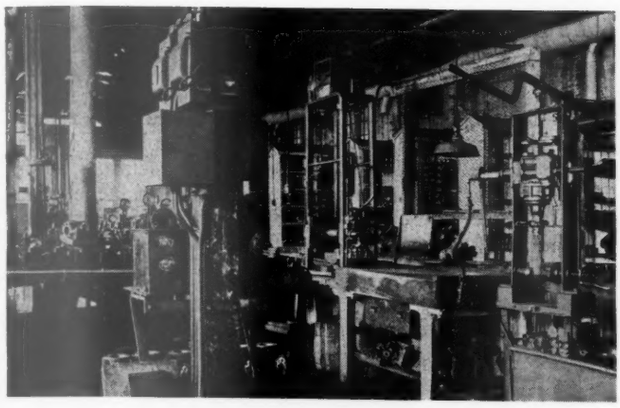
Gages, Steam
Steam hose
Steam-heat connectors
Steam-heat valves
Cocks, Drain
Cocks, Gage
Cocks, Tender tank
Cocks, Blow-off
Pneumatic fire doors
Reverse gear cylinder valves
Injectors
Lubricators
Regulators
Water-scoop cylinders
Stoker drain and opert. valves
Headlight generators
Train-control equipment

Shop Equipment

This shop is equipped with machine tools and shop facilities for handling the work of the various sections, the major machine tools being as follows:

Sensitive, vertical and radial drills
Engine lathes
Piston rod grinder
Horizontal boring machine
Turret lathes
Internal grinders
Tool grinders
Lapping machines
Angle-cock grinding machines





Triple valve dismantling benches

Parts to be repaired are received at the shop in containers

The locations of these machines in the various sections are shown on the shop-layout drawing.

Wherever possible in the Pitcairn shop the work has been arranged in such a manner that the various opera-

SHEET No. 1

WEEKLY ORDER ON CENTRAL REPAIR POINT FOR REPAIRED UNITS FOR SHIPMENT

DISTRIBUTING SHOP _____ CHARGE _____ DATE _____

_____ DATE SHIPPED _____ REPORT No. _____

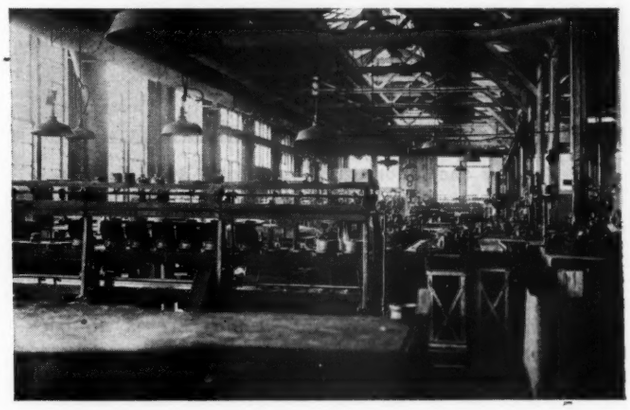
_____ PRR No. _____ LAST CAR RECEIVED _____

Car No. Mfd. Returned In.

_____ Ship to _____ At _____

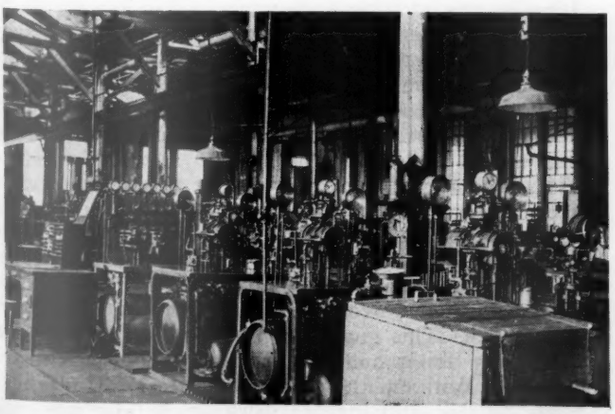
Amount and Reference No.	Returned for Repairs		Description	Authorized	On Hand	Additional Required	Amount Shipped
	Quantity	Date					
1-135			Hose, E. T. 1¼" x 22"				
1-336			Whistles, Rear End-Pipe				
1-339			Whistles, Rear End Comp.				
1-1760			Valves, P-1 Triple				
1-1770			" P-2 "				
1-1826			" F-2 "				
1-2047			Portions, Diap. 1" & 1¼"				
1-2048			" Steam 1"				
1-2092			Cocks, 1¼" Cutout				
1-2136			" 1" "				
1-2156			Valves, Car Discharge				
1-2233			¾" Cutout Cocks				
1-2360			Valves, Sig. Red.				
1-2626			" S-3 Brake				
1-2663			" Pullman Red.				
1-4160			" A-1 Cond'r.				
1-4233			" F-1 Triple				
1-5098			" Dbl. Check				
1-7716			½" Drain Cocks				
1-7800			Rel. Valves, Type 25-80				
1-8053			Cocks, ½" Cutout				
1-10526			Valves E-1 Safety				
1-11905			Cocks, 1" Cutout				
1-15213			½" Cutout Cocks				
1-X154889			Strainers, Air, 6½"				
1-X154899			" " 9½"				
1-15549			Valves, E-7 Safety				
1-15890			" E-6 Safety				
1-16370			" L-3 Triple				
1-17679			Portions, Steam, 1½"				
			" "				
1-27682			Valves, K-1 Triple				
1-30790			" K-2 "				
1-41263			" Water Scoop				
1-50772			Cocks, 1" special cutout				
1-51498			Pumps, 9½" Air				
1-58808			Valves, H-6 Brake				
1-59429			Strnr. & Ck. C1-3-8				

Part of one of three sheets of forms for ordering parts from central shop



A close-up of the roller conveyors in the triple valve section

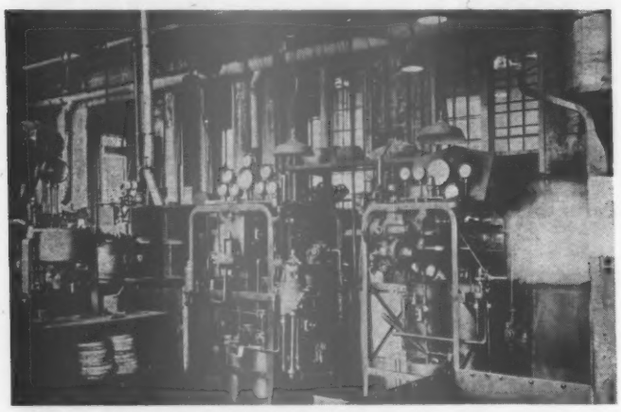
tions are handled in sections and by straight-line methods. Probably the best illustrations of this in the operation of the shop are provided by the work of the triple-valve sections; the feed-, brake- and distributing-valve sections, and the hose repair section. In the triple-valve section, for example, the valves are brought into the shop in containers on skids as they are unloaded from the cars from outlying points and pass successively through several operations wherein they are dismounted and the parts placed in trays for convenient handling and inspection. They are then cleaned, oiled and assembled and pass over a battery of test racks where very



Triple valve test racks showing the new AB rack

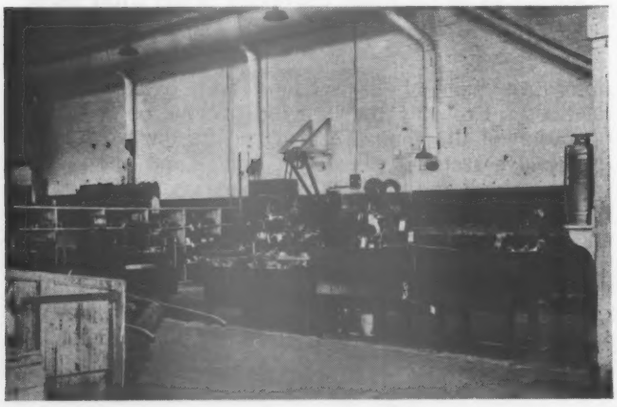
Another view of the triple valve section

careful tests are made to determine their fitness for service. Thus, valves which pass all of the rigid tests are OK'd for service and shipped to the outlying storehouse points. Valves which fail to pass the test return again to the beginning of the repair line to be torn down, repaired and assembled and again passed over the test racks. In order to facilitate the work in these several sections which handle a large number of small parts,



Two of the locomotive equipment test racks

such as those mentioned, a great many ingenious devices have been developed for handling the work as economically as possible and the various facilities used in the repair work, such as repair benches and test racks, have been located in such a manner that there is no backtracking of the parts and practically no necessity for the workmen leaving their stations in order to secure parts, materials or the tools required in their work.



The pneumatic tool repair section

As may be seen from the shop layout drawing, particularly in the triple-valve section, roller conveyors have been utilized to a great extent to transport the trays containing parts and finished valves from one point in the section to another. In order to assure the proper functioning of the important locomotive and car parts, such as are repaired in this shop, a very careful inspection system has been established and numerous gages are used to check the limits of wear and the fits of parts.

Details of the operations performed in the major sections of the Pitcairn air brake repair shop, together with a description of the repair and inspection methods on such parts as air pumps, triple valves, feed and distributing valves and air brake hose will be covered in articles to be published in subsequent issues.

Renewable-Disc Air Nozzles

TWO new designs of bronze air nozzles with renewable non-metallic discs have been placed on the market by the Lunkenheimer Company, Cincinnati, Ohio. One is made with an integral hose end and the other with a female pipe end. Either pattern can be furnished with pointed, flat or extension tip. These air nozzles are suitable for blowing dust, dirt, chips, filings, borings and

The new Lunkenheimer air nozzles are made with either pipe or hose connections

other matter, being more effective and safer to use than brushes, rags or hand bellows.

The valve disc is especially compounded for air service and can be easily renewed by simply unscrewing the nut at the bottom of the nozzle, removing the spring and old disc and then inserting a new disc. Provision is made for hanging the air nozzle on a nail or small hook when not in use.

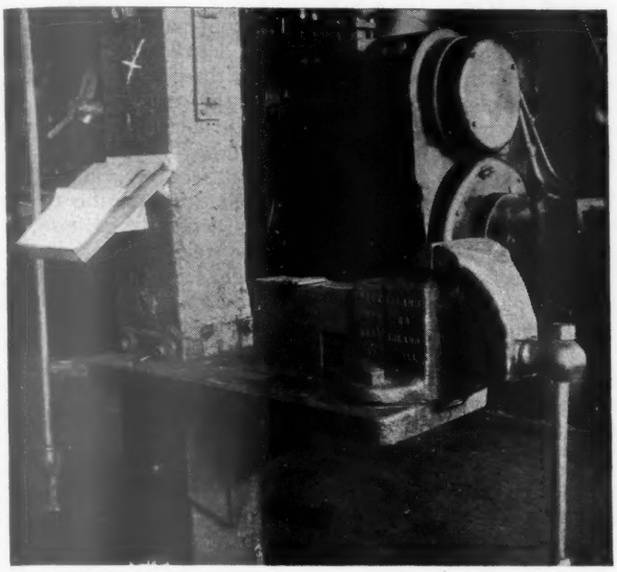
Vise Table and Engine-Report Holder

A CONVENIENT application of a small vise bench and a galvanized iron engine-report holder to an enginehouse roof-support post is shown in the illustration. The vise bench is made of cast iron from a standard pattern designed to fit the enginehouse post. This vise table is equipped with a standard Rock Island 8-in. machinist vise, affording a rigid support for the vise and having the additional advantages of occupying very little room in the enginehouse and, moreover, leaving the floor entirely clear of table legs which might interfere with the movement of trucks and material through the shop. This construction also reduces greatly the difficulty of keeping the enginehouse floors clean and in a well picked-up condition.

Vises of this type are provided at regular intervals between stalls in the enginehouse shown, 20 per cent of the vises being pipe vises or equipped with combination pipe jaws. A feature of this vise installation is the provision of a special guard made of ⅛-in. sheet steel and positioned over the sliding vise-jaw extension, as illustrated. This guard serves as an anvil block for straightening shims and other light work of a similar character. Without the guard, workmen almost invariably do this straightening work on the vise-jaw extension itself, which in a short time becomes chipped or

battered to such an extent that it will not slide readily through the stationary jaw guide.

The sheet metal writing stand and engine-report holder is applied to the enginehouse post, as illustrated,



Engine-report container and vise bench applied to an enginehouse column

being installed at frequent intervals about the house so that inspectors will lose no time in getting to a place where their reports can be readily made out. The box-like construction of the writing stand adds to its stiffness, in conjunction with the diagonal supporting brace, part of which can be seen in the illustration. The provision of a pocket under the writing surface of the stand makes a safe place where engine reports may be kept clean while repairs are being made on the locomotive. Moreover, the reports are readily available for examination by the enginehouse foreman or other authorized supervisor.

Building Up Motion Parts With Wear-Resisting Bronze

MANY ways have been tried for increasing the service life of locomotive parts subject to wear. Case-hardened steel has the necessary strength and durability and is used successfully in many applications. In others, however, cutting or galling results and frequent renewal of the parts becomes necessary. Brass against steel makes a good wearing combination where the brass has the proper composition and can be supported suitably so as not to be subject to breakage. Similarly, babbitt against steel gives good results where unit bearing pressures can be kept low and high temperatures avoided. The application of bronze-welded bearing surfaces to locomotive parts is also affording increased service life, either with or without babbitt inserts.

Referring to the drawings, two applications of Oxweld No. 25-M bronze are shown: First, to a steel floating collar; and, second, to a Laird-type crosshead shoe. In the case of the bronze-coated steel floating collar, this collar is particularly adapted for use between the sides of main-rod front ends and the inside surfaces of crossheads, on main pins between main rods and side rods and in other locations where bronze collars are required.

The collar is constructed by coating the surfaces *D D* of a sheet metal washer of the proper size, the thickness of the plate *C*, Fig. 1, being approximately one-third the finished thickness of the collar to allow for a bronze coating of sufficient thickness on each side.

Mill scale, dirt, grease and other foreign substances are first removed from both sides of the plate, after which the bronze is applied with a suitable flux in the conventional way, using the minimum size welding head in the application. When the first side of the collar has been coated with bronze to the thickness desired, the collar is laid with the bronze side down on a cast iron face plate or reasonably heavy iron section so that the

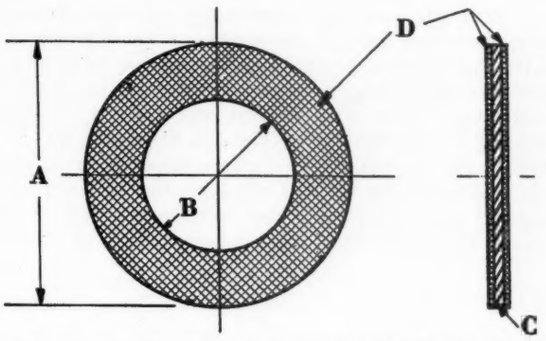


Fig. 1—Application of wear-resisting bronze to a steel floating collar

applied metal will not be melted away from the plate while the second side is being built up.

After both sides of the foundation plate have been coated with bronze, as outlined, the plate is straightened, if necessary, and machined to the dimensions required in the usual way. Floating bronze collars of this type have all of the wearing and other qualities of solid bronze collars and the additional advantage that they will not break and drop out of position as frequently happens with collars of solid bronze.

A combination babbitt-and-bronze bearing surface of exceptional wearing quality may be applied to a Laird-type crosshead shoe by building on retaining lugs and strips as indicated at *B B*, Fig. 2. The special bronze rod is applied by the oxyacetylene method and the space

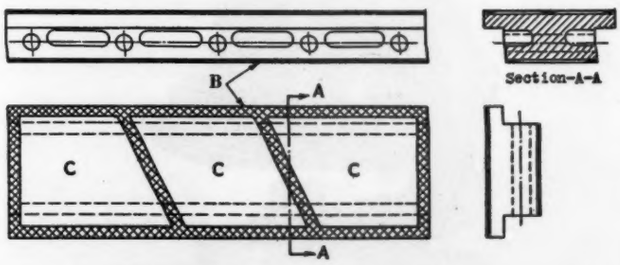


Fig. 2—Combination bronze- and babbitt-bearing surface on Laird-type crosshead

between the lugs and the edge retaining strips *C C C* filled with babbitt or a similar bearing metal.

Laird-type crosshead shoes are designed to allow space for a bearing liner on the surface which make contact with the guides, ¼ in. or more in thickness;

therefore, this allowance need not be changed for the application of the combination babbitt and bronze bearing surface, providing it is at least ¼ in. A retaining strip ⅝ in. or ¾ in. in width and of the thickness required is built along the edges of both sides and across the ends of both sides of the shoe. In addition, two strips or lugs are built across both surfaces, spaced equally between the strips across the ends, as indicated in the drawing. When the lugs and strips are applied to exceptionally long shoes, three cross lugs instead of two are applied.

The strips around the edges of the shoe, also both sides of the cross strips, should be in dovetail form on the inside, a design which will overcome any possibility of the babbitt becoming loose and breaking out. The dovetail edge is obtained by building the bronze against a piece of carbon block or bar copper beveled to the angle desired, which is usually approximately 30 deg.

The original liners should first be removed from the shoes and the surfaces thoroughly cleaned from oil, grease or other foreign substances. The bronze strips and lugs are then built up to sufficient thickness to allow stock for machining, after which the sections between the lugs are filled with babbitt and the entire surface machined to standard dimensions in the usual way.

When the combination bearings become worn to the limit, additional bronze is applied on the surfaces of the retaining strips and lugs, the babbitt between the sections repoured and the surfaces remachined to standard.

Tap Chaser Rake Grinding Attachment

THE Landis Machine Company, Tap Division, Waynesboro, Pa., has developed a fixture for use in regrinding or sharpening the chasers used in Style LT and Style LM Landis receding chaser collapsible taps.

Correct grinding or sharpening of collapsible tap chasers is vital to their efficient performance as im-

Landis tap chaser rake grinding attachment

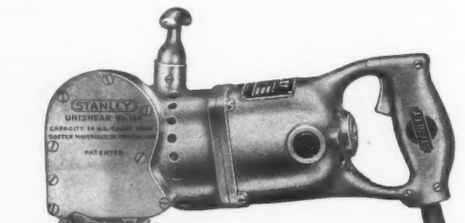
properly ground chasers often mean poor threads and short life. It is important that the rake angle be ground suitable for the material being tapped as different rake angles are required for the different materials.

This attachment is composed of three main parts: First, a base for fastening to the table the grinding machine. Attached to the base is a second part, the swivel bracket, which is adjustable in a horizontal plane in relation to the base. The bottom part of the swivel bracket is graduated to give the desired degree of azimuth, which is the angle at which the chaser is set from the parallel. The third part of the attachment is the vise base which is clamped to the swivel bracket and holds the chaser while being ground. The vise base can be rotated in a vertical plane and securely clamped at any angle as determined by graduations on the top of the swivel bracket. This permits setting the chaser at the proper elevation for grinding the gun tap in the throat section of the rake. The chaser to be ground is held in place against a milled flat by an adjustable spring clamp and locked with a hand screw.

This attachment is suitable for grinding all sizes of chasers employed in the Style LT collapsible taps, Style LM receding chaser collapsible taps and also those employed in the Victor collapsible and receding chaser taps formerly manufactured.

Portable Shears for Sheet Metal

THE portable Stanley-Unishear recently brought out by the Stanley Electric Tool Division, New Britain, Conn., cuts up to 14 gage hot rolled steel, other materials in proportion, at a speed up to 15 ft. per min. and weighs only 19½ lb. It cuts straight lines, curves,



Stanley-Unishear No. 144

angles and notches with accuracy. In cutting curves it can operate with a minimum radius of 2½ in. either right or left hand. Inside cuts can be made by punching a 3-in. hole and slipping the yoke through. With this tool large sheets can be cut and trimmed and turned-up edges cut off close to the surface on the job. By carrying the machine to the work instead of the work to the machine cutting time and expenses are reduced.

Among its mechanical features are a powerful universal motor and a steel worm mounted on seal type ball bearings; bronze worm gear and heavy alloy steel eccentric shaft mounted on ball bearings; gear case, sealed against oil leakage and entrance of dirt, with mechanism enclosed in a continuous oil bath; aluminum alloy housing of compact design; blades easily removed for sharpening; heat-treated steel yoke with micrometer blade clearance adjustment. The No. 144 Stanley-Unishear is furnished for either 110, 220 or 250 volts, as specified.

Among the Clubs and Associations

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—F. S. Hasse, general manager, Oxweld Railroad Service Co., Chicago, will present a paper on Oxy-acetylene Welding and Cutting before the meeting to be held at the Ansley Hotel, Atlanta, Ga., at 10 a.m., March 21.

NEW ENGLAND RAILROAD CLUB.—At the annual meeting, to be held at 6:30 p.m. on March 12 at the Copley-Plaza Hotel, Boston, Mass., a Bethlehem Steel Company picture on the manufacture of steel, with particular reference to structural sections, will be shown. Election of officers.

Relation of P. & S. Departments to Railroads and the Public

Western Railway Club.—Meeting held Monday evening, February 18, at the Hotel Sherman, Chicago. Address by U. K. Hall, general purchasing agent, Union Pacific, on the subject "The Purchasing and Stores Departments—Their Relation to Railroads and the Public." In discussing this subject, Mr. Hall said: "The stores department of the average Class I railway has in stock from 50,000 to 80,000 items of material. . . . The Investment in materials and supplies on Class I railroads in the United States amounts to approximately $300,000,000. . . . It is costing the railroads approximately 16 per cent to carry materials in stock, counting interest on the investment, handling charges, deterioration, obsolescence, insurance, taxes, etc. Thus, it is necessary to hold the stock down to the lowest consistent working basis. ¶"The delivery of materials from stores stocks to users presents opportunities for large economies. . . . There is no operation on a railroad where more money can be saved or where money can more quickly be lost than in reclamation. The deciding factor is cost accounting plus effective supervision. . . . ¶"In the last few years particularly, emphasis has been placed on simplification. The elimination of needless and unnecessary sizes produces economies for the user in reducing carrying charges and the cost of handling unnecessary items, and, for the manufacturer by making quantity output possible. ¶"In recent years, the use of material handling devices has contributed much to economy in operation. . . . Most of the larger roads are equipped with both trailers and skids and continual study is made by the stores department and the manufacturers to extend the use of this equipment. . . . With the increased use of equipment, there is a crying need for concrete roadways. Unless suitable roadways and crossings are installed, the maintenance of the equipment is expensive. ¶"Any discussion of the subject of materials and supplies would be incomplete without emphasizing the importance of that great strong right arm of the purchasing department, namely, the engineer of tests. Where an engineer of tests works in conjunction, harmony and unity with the purchasing agent, he is a most valuable ally of the service. Upon the engineer of tests devolves the responsibility of seeing that proper materials are received, and that they measure up to and comply fully with the well-worked-out specifications for material. With the proper specifications, and a competent test department, the purchasing agent is in a position to know that the material he orders and receives complies with the specifications and is suitable for the purpose ordered and for which the railroad is paying. ¶"The railroad industry as a whole represents the largest users of material, and there is no state in the Union that is not vitally affected by railroad purchases, and, therefore, by railroad prosperity. Great manufacturing and distributing centers in the east and middle west are dependent to a large extent upon the purchasing power of the railroads. When the railroads prosper, they prosper. In time of depression when the railroads cannot buy, their factories will run largely on a limited basis. Let us present these facts to the public."

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, c/o Westinghouse Air Brake Company, Thirty-fourth floor, Empire State Bldg., New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

ASSOCIATION OF AMERICAN RAILROADS.—J. R. Downes, vice-president operations and maintenance department, Transportation Building, Washington, D. C.

DIVISION I.—OPERATING.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

COMMITTEE ON RESEARCH.—H. A. Johnson, chairman (Director of Research, Association of American Railroads), Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION VIII.—MOTOR TRANSPORT.—CAR SERVICE DIVISION.—C. A. Buch, Transportation Building, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 260 S. Broad street, Philadelphia, Pa. Thirty-eighth annual meeting, June 24-28, Book-Cadillac Hotel, Detroit, Mich.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, 192 E. Cedar st., Livingston, N. J. Next meeting, Cincinnati, Ohio, June, 1935.

MACHINE SHOP PRACTICE DIVISION.—G. F. Nordenholt, 330 W. Forty-second st., New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—M. J. Reed, 2 W. Forty-fifth St., New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 W. Madison St., Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMAN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—E. R. Phillips, car department, Chicago & North Western Railway, Council Bluffs, Iowa. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn. 1935 meeting tentatively planned for May 2 to 4, inclusive, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—Ralph D. Stewart, 21 Sherrard avenue, Greenville, Pa. Regular meeting third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, Association of American Railroads.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—R. H. Burgess, Box 8, Terminal A, Toronto, Ont. Meetings, first Friday of each month except June, July, August and September.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

Illinois Central Car Repairs

THE largest amount of classified equipment-repair work ever turned out on the Illinois Central in a comparable length of time was completed during 1934 when 14,000 freight cars, 300 passenger cars and 700 locomotives were reconditioned.

Milwaukee High Speed Train

ALL welded, light weight, standard steel cars will be used in the fast trains which the Chicago, Milwaukee, St. Paul & Pacific will operate between Chicago and the Twin Cities early in the spring. The train will carry a cafe and a parlor car in addition to new type day coaches, all of which will be air-conditioned. The illustration on page 123 shows one of the two rear cars now nearing completion in the company shops.

D. L. & W. to Purchase Shop Machinery

THE Delaware, Lackawanna & Western will shortly purchase new shop machinery and equipment to augment existing facilities and to replace obsolete equipment. The company is now asking for prices on:

1 36-in. turret lathe
1 portable heavy-duty, geared head lathe
1 heavy-duty, geared head, lead screw cutting engine lathe
3 portable electric welding sets
2 industrial trucks
1 electric metal melting pot
1 2-ton electric hoist

North Western's "400" Averages 320 Persons Daily

DURING the 30 days from January 2 to January 31, the "400" of the Chicago & North Western, operating between Chicago and the Twin Cities, carried 9,591 passengers or 320 persons daily. At the same time the earnings of this train have been more than double the direct cost of operation. The patronage of the train, more than two-thirds of which has consisted of through passengers between Chicago and the Twin Cities, has not been taken from other North Western trains operating between these points. Based on figures in and out of the Chicago passenger station for the first 26 days, the average number of travellers on trains between these points, including The Viking, The Victory and The North Western Limited, has been five per cent more than for the same period in January, 1934. Since its inauguration on January 2, the "400" has carried an extra parlor car on every trip.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of system	Builder
C. of Ga.	2[1]	Buffet coach	Steam eject.	Safety-Carrier
C. & N. W.	67[2]	Standard and tourist sleep.	Mech. and ice	.....
	37[2]	Coaches		
	31[2]	Dining, Parlor and observa.		
	54[3]	Coaches and lounge	Multiple system	Waukesha Motor Co.
C. B. & Q.	2	Coaches	.....	Pullman-Std. Car Mfg. Co
C. M. St. P. & P.	123[4]	.....	Steam-jet	Safety Car H. & L. Co.
D. L. & W.	10	Coaches	.....	Pullman-Std. Car Mfg. Co
F. E. C.	3[5]	Diners	Steam-jet	Safety Car H. & L. Co.
	8[5]	Coaches		
L. & N.	25	Sleep. and parlor	Ice-Mech.	Pullman Co.
	5	Diners	Steam-jet	Safety Car H. & L. Co.
N. & W.	8[6]	Coaches	Electro-mech.	.....
Nor. Pac.	6	Diners	.....	Pullman-Std. Car Mfg. Co.
	4	Observa.		
	12	Coaches and smok.		
Pennsylvania[7]	39	Coaches	.....	.....
	20	Comb. pass. and bagg.		
	19	Dining		
Texas & Pac.	1	Diner	.....	Pullman-Std. Car Mfg. Co
Union Pac.	25	Chair cars and coaches	.....	Safety Car H. & L. Co.
	10	Chair cars and coaches	.....	General Elec. Co.
	5[8]	Chair cars and coaches	.....	York Ice Machy. Corp.

[1]These cars will be equipped with one 7½ kw. generator having a flat belt drive and with an Edison storage battery of 600 amp. hr. capacity. The company is remodeling the car interiors and installing bucket type seats and a buffet.

[2]The work on these 135 cars, which are to be equipped this year, will be done in the shops of the C. & N. W.

[3]54 Waukesha-Melcher units for use in day coaches and lounge cars of San Francisco-Overland Limited.

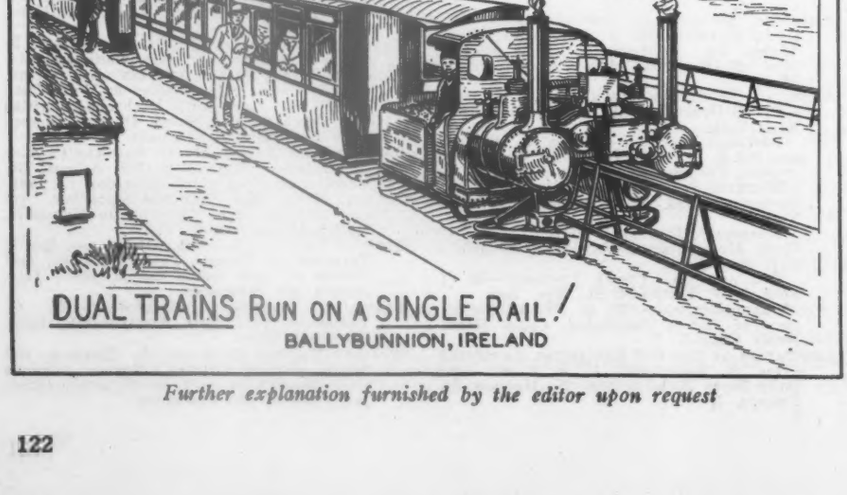
[4]68 railroad owned; 55 Pullman owned. Being installed in company shops.

[5]The Florida East Coast last year installed air-conditioning equipment in six Pullman lounge and sleeping cars, using the mechanical system of the Pullman Company. The cars are equipped with one 15 kw. and one 4 kw. generator and an Exide storage battery of 1,000 amp. capacity. The 3 dining cars listed here will be equipped with Edison storage batteries of 750 amp. hour capacity and the eight coaches with Edison storage batteries of 600 amp. hour capacity. Electric power will be provided by one 3 kw. and one 5 kw. generator on the diners and by one 3 kw. and one 4 kw. generator on the coaches.

[6]Approximately $80,000 will be spent for the air-conditioning and remodeling of these standard passenger coaches. The work will be carried out in the railroad's Roanoke, Va., shops. The project will include the construction of new arched ceilings, the installation of dome lights, laying of new rubber tile floors and repainting the interior of the cars. The railway spent more than a million dollars during 1934 on passenger improvements.

[7]Work will be started at once by the Pennsylvania and the Pullman Company installing air-conditioning equipments in additional cars in Pennsylvania service so that all the east and west through trains will be so equipped and ready for service in May. This will bring to 887 the total of air-conditioned cars, both Pullman and P. R. R., in service on the Pennsylvania. The installation and class repairs on the 78 Pennsylvania cars listed here will be carried out in the company's shops at Altoona, Pa.

[8]An order has been placed with Fairbanks, Morse & Co., for axle-driven generators and motors for driving compressors, condenser fans, air conditioner and distribution fans for these cars.



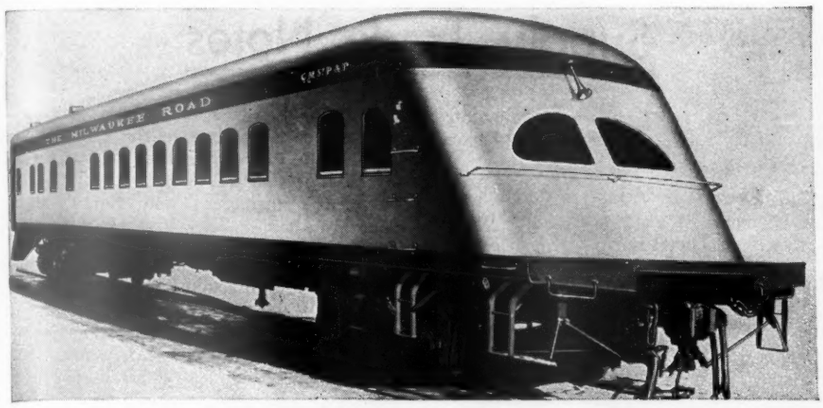
Further explanation furnished by the editor upon request

Union Pacific M-10,000 in Service

THE Union Pacific streamline train, M-10,000, was placed in service between Salina, Kan., and Kansas City, Mo., on a 3½ hour schedule for the 187 miles on January 31. During the first six days of operation, it carried an average of 100 persons a trip. The train stops at Lawrence, Topeka, Wamego, Manhattan, Junction City, and Abilene. It leave Salina at 7:00 a.m. and arrives in Kansas City at 10:30 a.m., leaves Kansas City at 4:00 p.m. and arrives in Salina at 7:30 p.m.

Frisco Builds Combination Sleeping Cars

THE St. Louis-San Francisco has built two combination sleeper-buffet-coach cars, the "Memphis" and the "Pensacola" which have been placed in service between Memphis, Tenn., and Pensacola, Fla. In the construction of these converted cars welding instead of riveting has been employed so that there are no rivets in the sides or roofs. The cars contain six sleeping sections, the service for which is provided by



"Beaver Tail" cars will be used on the rear of C. M. St. P. & P. high-speed trains

the railroad, a buffet in the center of the car which is capable of seating 12 people, and a coach section which seats 30 people. Each car is air conditioned throughout, with two separate cooling units, one in each end of the car. The overhead heat is controlled by thermostats. These cars were under construction at the Frisco's West Shops at Springfield, Mo., for five and one-half months. Two all welded, combination mail and baggage cars for this service are now under construction and will be placed in operation.

German Railways Plan To Place Large Equipment Orders

THE German railway equipment industry is showing considerable activity in anticipation of substantial orders from the German railways, according to a recent report from Vice Consul J. H. Wright at Cologne to the United States Department of Commerce. The report states that negotiations are now under way for the delivery of new rolling stock during the first half of this year.

Included in the order will be locomotives and cars of new design, particular attention being given to streamline equipment for freight as well as passenger service. The report also reveals that experiments are being conducted with self-propelled freight cars of the Diesel-electric type, these cars to be of welded steel and equipped with unloading devices. It is also hoped that it will be possible to design these motor freight cars for speeds as high as 80 m.p.h.

British Steam Train Makes Fast Run with Old Locomotive

WITH a regular passenger train hauled by a locomotive 27 years old the London & North Eastern of Great Britain recently achieved an average speed of 60 m.p.h. for the 185.8-mile run from Kings Cross to Leeds. The overall time of 185 min. 40 sec. included two complete stops for adverse signals and three further signal checks en route. The net time of the run was 175 min., and over 136 miles a net average speed of 70 m.p.h. was maintained. The run, the details of which were made public by the Associated British Railways, Inc., New York, is called in the announcement an exploit which parallels "the operations of the '400'—a 60 m.p.h. standard steam train recently introduced by the Chicago & North Western Railway with great success."

The British announcement adds that while the railways in that country "have made some experiments with streamline equipment, this L. N. E. achievement would prove that further acceleration of train services will not depend merely on latest locomotive types, streamlining or Diesel operation to make the gains of time effective in practice."

Diesel Locomotive Plant Planned by General Motors

THE General Motors Corporation has taken an option for the purchase of property near Chicago where it expects to proceed immediately, through its subsidiary, the Electric-Motive Corporation, with the construction of a new Diesel locomotive manufacturing plant.

Diesel engines for the Electro-Motive Corporation will continue to be supplied by the Winton Engine Corporation, a subsidiary of General Motors, from its Cleveland plant. Winton is supplying engines for a number of locomotives now in the course of construction. The Winton-Diesel engine is used as a power plant on the Burlington Zephyr, the Union Pacific's M-10001 and the new Flying Yankee of the Boston & Maine and Maine Central.

The Electro-Motive Corporation was a pioneer in the development of rail cars powered by automotive equipment. The company was organized in 1922, at a time when railroads were beginning to use motorized cars particularly on the short lines. Its first cars were placed in service in 1924 and proved successful.

The construction of the first unit of the new plant will begin immediately and it is expected that it will be operating by August of this year. The Austin Company of Cleveland has been awarded the contract for its design and construction.

Depreciation Percentages Prescribed for Short Lines

STATING that 93 short-line railroads have not filed with it estimates of composite annual percentage rates of depreciation as required by its order of July 28, 1931, as amended, the Interstate Commerce Commission has issued an order providing that with the accounts for April, 1935, the listed carriers shall account for depreciation charges under the order by applying to the ledger value of equipment used in their operations, whether owned or leased, the following annual composite percentage rates:

Account No.	*Name*	*Rate, Per Cent*
51	Steam locomotives	3.25
52	Other locomotives	3.25
53	Freight-train cars	3.50
54	Passenger-train cars	2.75
56	Floating equipment	2.50
57	Work equipment	3.50
58	Miscellaneous equipment	12.00

The estimates were to have been filed by September 1, 1934, by an order of June 13, 1934, amending the uniform system of

A night scene in the engine terminal yards of the "Ucon Railroad," a part of the model railroad system in operation during the annual exhibit of the New York Society of Model Engineers

accounts for steam railroads, operating steam railroad companies were authorized, until rates are prescribed by the commission, to apply depreciation percentage rates developed in accordance with the instructions contained therein.

Terminal Servicing for Air-Conditioning Apparatus

UPON instructions from the General Committee of the Mechanical Division of the A.A.R., the following recommendations from the Committee on Research and the Committee on Locomotive and Car Lighting relative to standardization of terminal servicing for air-conditioning apparatus on passenger cars, for adoption as recommended practice, were submitted to letter ballot January 7, 1935:

1. That all standby motors on air-conditioned cars be connected for operation on a 220-volt, 3-phase, 60-cycle source of power.
2. That the plugs and receptacles be in accordance with the drawings recommended.
3. That leads from transformer to receptacle on right-of-way and cords and plugs be connected as recommended.
4. That receptacles in parallel be located on the car in such manner that the car may be readily serviced from either side.

The vote on each of the propositions being favorable they were approved by the Association of American Railroads and became effective on March 1.

Supply Trade Notes

W. A. HAUCK has been appointed assistant to the president of the Lukens Steel Company, Coatesville, Pa.

THE BORDEN COMPANY, Warren, Ohio, has changed its corporate name to the Beaver Pipe Tools, Inc.

THE PARCAR CORPORATION has moved its office from 230 Park avenue to 75 West street, New York.

WILLIAM BIERMAN has been appointed assistant to the president of the Pullman-Standard Car Manufacturing Company, Chicago.

W. F. GRADOLPH, general sales manager of the DeVilbiss Company, Toledo, Ohio, has been elected vice-president in charge of sales, with headquarters at Toledo.

S K F INDUSTRIES, INC., Philadelphia, Pa., has opened a new branch at 407 South Fourth street, Minneapolis, Minn., with A. Kishkunas in charge.

EDWARD M. COLLINS has been appointed western railroad sales representative of S. Karpen & Bros., with offices at 618 Railway Exchange Building, 80 E. Jackson Blvd., Chicago.

SYLVESTER A. MAHAN has been appointed works manager of the Philadelphia plant of the Edward G. Budd Manufacturing Co.; Joseph W. Meadowcroft, assistant works manager; and Earl Blaine, chief inspector.

GEORGE A. BENNIS, formerly representative of the Nickel Plate-Lackawanna Dispatch Line, has become associated with the General American Transportation Corporation in the refrigerator car department, with headquarters at Chicago.

THOMAS H. DOOLING, manager of the Boston, Mass., office of the Electric Storage Battery Company, has been transferred as manager to its San Francisco, Cal., branch.

THE AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has appointed the Edgecomb Steel Corporation, Newark, N. J., a distributor of its Armco stainless steel sheets, plates and strips.

W. R. WALSH, resident sales manager at Chicago for the Ewald Iron Company, Louisville, Ky., has been elected a vice-president of the company, with headquarters at Chicago.

R. G. ANGELL has been transferred from the engineering service department of the A. M. Byers Company, Pittsburgh, Pa., to the railroad sales department, with headquarters at Philadelphia, Pa.

FRANK A. LIVINGSTON, vice-president and treasurer of the Ralston Steel Car Company, Columbus, Ohio, has been elected president and general manager to succeed Francis E. Symons, deceased.

LEON C. ROY, secretary and assistant treasurer of the Ralston Steel Car Company, Columbus, Ohio, has been appointed secretary and treasurer and Blair C. Hanna has been appointed manager of sales.

THE GOULD STORAGE BATTERY CORPORATION, Depew, N. Y., has moved its Chicago office from 32 West Randolph street to larger quarters at 227 Garvey court, Chicago, where it will maintain a district office and service station with facilities to handle its increased business.

THE NAME OF the Ohio Power Shovel Company, a wholly owned subsidiary of the Lima Locomotive Works, Inc., Lima, Ohio, has been changed to Lima Locomotive Works, Inc., Shovel and Crane Division.

R. C. OVERSTREET has been appointed purchasing agent of the Young Radiator Company, Racine, Wis. Mr. Overstreet was formerly connected with the Mueller Furnace Company, Milwaukee, and purchasing agent for the Nash Motors Company, of Racine.

THE GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., has appointed George F. Motter's Sons Supply Company, York, Pa., dealer-agents in the York area.

(Turn to next left-hand page)

New Equipment

CAR ORDERS

Purchaser	No. of cars	Type of car	Builder
Barrett Co.	6	Tank	American Car & Fdy. Co.
Cinn., N. O. & Tex. Pac.	300[1]	40-ton automobile	Pressed Steel Car Co.
C. & O.	5	50-ton hopper	Bethlehem Steel Co.
C. B. & Q.	5	Lt. wt. hopper	Pressed Steel Car Co.
Liquid Carbonic Corp.	5	40-ton box	American Car & Fdry. Co.
Merrimac Chemical Co.	1	70-ton tank	American Car & Fdry. Co.
	1	40-ton tank	
Niacet Chemicals Corp.	3	Tank	American Car & Fdry. Co.
Nor. Pac.	6[2]	De luxe coaches	Pullman-Std. Car Mfg. Co.
Northern Refrig. Line, Inc.	500	Refrigerator	Merchants Despatch, Inc.
Nor. Sou.	2	Gas. rail motor (mech. drive)	American Car & Fdry. Co.
Pennsylvania Salt Mfg. Co.	2	4,000-gal. tank	General American Trans. Corp
	2	6,000-gal. tank	

CAR INQUIRIES

B. & O.	50 to 150	Hopper, for cement	.....
C. B. & Q.	500[3]	Composite coal	.....
Chilean State Rys.	15	First-class pass.	.....
	6	Sleeping	.....
North-Western of Brazil	195	Cattle (Large)	.....
	5	Cattle (Small)	.....
	68	Gondola	.....
	150	Flat	.....
	300	Box	.....
Shippers Car Line	10, 25 or 40	40-ton cars for transporting dry ice	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
C. B. & Q.	1	4-6-4	Co. shops
Chicago Grt. Western	1	0-4-4-0 oil-elec. switcher	West. Elec. & Mfg. Co.
Sorocabana Ry.	4[4]	4-10-2	American Loco. Co.

LOCOMOTIVE INQUIRIES

United States Navy	2	25-ton diesel-elec. .....

MISCELLANEOUS ORDERS

Road	Type of equip.	For use on	Order placed with
C. M. St. P. & P.	Bearings	2 streamlined locos.[5]	S. K. F. Industries
Chilean State Rys.	Thermic syphons (10 sets of 2 each)	Locomotives[6]	Loco. Firebox Co.
Michigan Central	Loco-Valve pilots	15 Pass. locos.	Valve Pilot Corp.
Nat'l Rys. Mexico	Thermic syphons (12 sets of 2 each)[7]	Locomotives	Loco. Firebox Co.
Pennsylvania	Bearings and boxes[8]	37 new streamline locos.	Timken Roller Bear. Co.

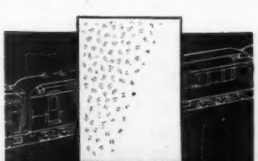
[1]Steel sheathed, wood lined, 40 ft. 6 in. long.
[2]The original inquiry was for 24 cars but only 6 will be purchased.
[3]Contemplated, for construction in own shops.
[4]These locomotives will be of meter gage and will have three cylinders; 18½ in. by 24 in. outside, 18½ by 22 in. inside, and 48 in. driving wheels.
[5]Being built by American Loco. Co.
[6]Being built in Germany.
[7]For application to 12 steam locomotives which are being thoroughly reconditioned to meet modern operating requirements. This installation will make a total of 84 syphon-equipped locomotives on the National Railways.
[8]This is in addition to the Pennsylvania's order placed with the Timken Company three months ago for roller bearings for all axles of 28 new electric locomotives and two experimental electric locomotives, making a total of 165 Pennsylvania electric locomotives with Timken bearings on all axles, including driving axles.

Speed is the keynote of future railway transportation. Special units running at 100 miles or more an hour have already been built.

But every mile an hour increase in speed means an increase in stress. The safe generation and transmission of higher power require better, stronger materials. The day when iron was iron and steel was steel has given way to the day of special alloy steels with characteristics precisely suited to the work in hand. Steels are developed by Republic Metallurgists for each particular job.

Strong nickel steel boiler sheets and firebox sheets to withstand high pressures; Agathon alloy forging steel that is unaffected by low temperatures; corrosion-resisting sheets and boiler tubes of Toncan Iron; staybolts of alloy steels that are stronger and tougher than the old materials; stainless steels for the new high speed trains.

These are just a few of the many special steels offered by Republic to meet the new conditions of modern railroading.



GALVANNEALED SHEETS
for AIR CONDITIONING

Galvannealed sheets in your air-conditioning ducts will lessen future maintenance. The protective coat won't flake or crack.

Republic Steel
CORPORATION
CENTRAL ALLOY DIVISION, MASSILLON, OHIO
GENERAL OFFICES: YOUNGSTOWN, OHIO

GEORGE GORDON CRAWFORD, who was president of the Jones & Laughlin Steel Corporation from February, 1930, to June, 1934, and since that time served as a director and chairman of its executive committee, has resigned all connections with the corporation to return to his home in Birmingham, Ala.

L. G. SULLIVAN, eastern sales representative at New York, of the Atlas Steel Castings Company, Buffalo, N. Y., has been elected a vice-president. Mr. Sullivan will continue in charge of eastern sales with headquarters as formerly at New York.

THOMAS O'LEARY, JR., formerly assistant sales manager of the Western division of the Transportation department, Johns-Manville Sales Corporation, has been promoted to manager of the Western division of the Transportation department, with headquarters at Chicago, Ill.

THE AMERICAN BRAKE SHOE & FOUNDRY COMPANY, New York, has purchased the plant and equipment of the Railway Materials Corporation at Toledo, Ohio. The plant will be known as the Toledo plant of the American Brake Shoe & Foundry Company and will be operated under the direction of W. H. Winters, vice-president in charge of operations.

GEORGE H. BUCHER, president and general manager of the Westinghouse Electric International Company, has been elected a vice-president of the Westinghouse Electric & Manufacturing Company, with headquarters at New York, retaining also his position as president and general manager of the Westinghouse Electric International Company.

F. C. HARPER, secretary and treasurer of the American Sheet & Tin Plate Company, Pittsburgh, Pa., a subsidiary of the United States Steel Corporation, has been elected vice-president and general manager of sales, J. I. Andrews, vice-president, having retired. F. M. Fuller, general manager of sales, has been appointed assistant to president; Percy Cooke, assistant secretary and assistant treasurer, has been elected secretary and assistant treasurer; M. L. Gardner, assistant treasurer, has been elected treasurer, and L. K. Hitchings has been elected assistant treasurer.

HUNTER MICHAELS, who has been appointed district sales manager of the American Locomotive Company, with headquarters at Cleveland, Ohio, was born in Chicago on September 26, 1889, and was educated in the public schools of that city and at Lewis Institute. He worked in the shops of several car manufacturing companies in the middle West as draftsman, estimator and traveling engineer, and in 1913 was appointed mechanical engineer of the Union Metal Products Company, Chicago. He enlisted in the Army in 1917 and served for 16 months as First Lieutenant of the 114th Engineers. He rejoined the Union Metal Products Company in 1919 and served as assistant manager until 1923. He then became sales agent of the Railway Steel-Spring Company at Chicago. When the company was absorbed by the American Locomotive Company in 1926, Mr. Michaels joined the sales staff of the latter company in Chicago, serving as sales agent and assistant to the vice-president until his appointment as district sales manager at Cleveland.

FRANK P. ROESCH, general sales manager of the Standard Stoker Company, Inc., has been appointed a vice-president and in this capacity will continue his direction of sales, with headquarters, as formerly, at Chicago.

THE EHRET MAGNESIA MANUFACTURING COMPANY, Valley Forge, Pa., has appointed the George A. Nicol Corporation, 500 Fifth avenue, New York, its exclusive sales representative in connection with sales of its products to railroads, locomotive builders and car builders. This company manufactures a large line of

George A. Nicol, Jr.

magnesia and asbestos products for use as locomotive lagging, car insulation, packings and other purposes. George A. Nicol, Jr., president of the George A Nicol Corporation, was formerly executive vice-president of the Johns-Manville Sales Corporation and has had an important part in the development of insulation and packing materials for the railroads during the past 25 years. Associated with him in this new Corporation are: Paul D. Mallay, assistant to the president; C. Allen Koenig, vice-president; Paul H. Twohey, vice-president, and William F. Kiesel, 3d, vice-president.

THE YOUNGSTOWN STEEL DOOR COMPANY has acquired the railway supply business of the Camel Company through an issue of stock. The Camel Sales Company, which for years has been the sales agent for Youngstown steel doors and Camel door fixtures, will continue as formerly, but in addition will handle other products which the Youngstown Steel Door Company manufactures. The Camel Sales Company will maintain its present offices at 332 South Michigan avenue, Chicago, and in addition will have offices at 500 Fifth avenue, New York, and in The Arcade, Cleveland, Ohio. All of the officers of the Camel Sales Company will continue in their former capacities. J. P. McWilliams, president of the Youngstown Steel Door Company, has been elected president of the Camel Sales Company to succeed William W. Darrow, deceased.

Reorganization Petition Filed by Baldwin

THE BALDWIN LOCOMOTIVE WORKS on February 25 filed in the United States District Court at Philadelphia, Pa., a petition seeking permission to reorganize under the provisions of Section 77 (b) of the National Bankruptcy Act. The action, brought on behalf of the parent corporation, in no way affects the status of any of the Baldwin subsidiaries.

Judge Dickinson, who presided at the hearing, entered an order approving the petition as complying with the statutory requirements and providing that the present Baldwin management may continue temporarily in possession of the properties and to operate the business as heretofore. Pursuant to the terms of the order President George H. Houston has announced that "the business of the Baldwin Locomotive Works will be continued for the present at least without cessation of operations or change in operating conditions or business relations."

The reorganization move was forecast in President Houston's annual report for 1934 wherein he called attention to the fact that operating losses experienced since 1931, together with bond amortization charges, have depleted the Baldwin working capital "until it is inadequate for present operating requirements and the payment of fixed charges." Mr. Houston then added: "Plans for meeting this difficult situation by reduction of fixed charges and provision of additional working capital are now being formulated and, when ready, will be submitted to all classes of security holders for their consideration."

In the report on the 1934 results President Houston points out that requirements of codes of fair competition under which the company's operations were carried on increased costs substantially; but competition prevented a corresponding increase in sales prices and therefore "the margin between sales price and prime cost was abnormally low." Also, because of this "the outlook for 1935 is uncertain," for, although the company started this year with more orders on hand than at the beginning of any other year since 1930, "these orders were taken at close prices, and are being performed now under the same conditions of high cost which prevailed during 1934."

The report also calls attention to the fact that a large portion of the company's 1934 business was financed by advances to the purchasers by the Public Works Administration. "The financing of railroad equipment by this medium," it adds, "has been particularly successful from the viewpoint of the volume of employment created in proportion to the volume of financing done and with regard to the promptness with which the securities resulting from some of these transactions have been marketed by the government agency holding them."

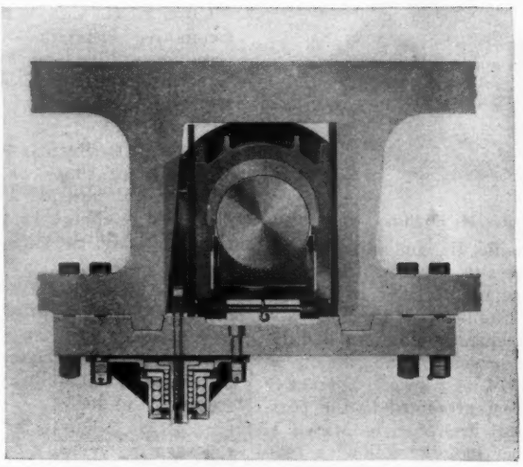
Obituary

M. FRANK RYAN, vice-president and western representative of the Pittsburgh Spring & Steel Company, Chicago, died at

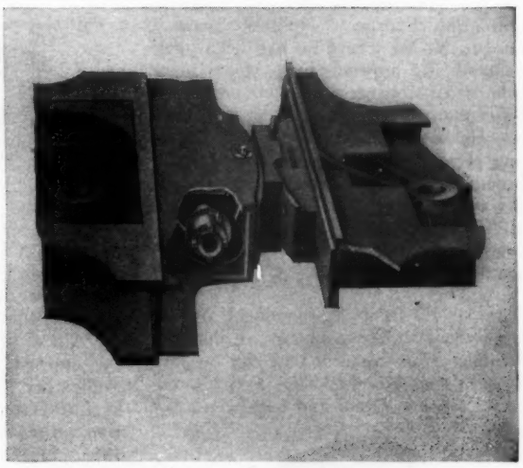
(Continued on next left-hand page)

The New Franklin TWINS *provide*

AN EASY RIDING LOCOMOTIVE AND A LOW MAINTENANCE LOCOMOTIVE



Franklin Automatic Compensator and Snubber



Franklin Radial Buffer—Type E-2

Hand adjusted Driving Box Wedges that either stick or allow slack; ordinary engine-tender buffers that bind, are two major causes of excessive locomotive maintenance.

The new Franklin Automatic Compensator and Snubber automatically maintains adjustment of driving box fit regardless of wear or temperature change.

The new Type E-2 Franklin Radial Buffer automatically provides free universal movement yet maintains at all times normal contact between engine and tender.

By automatically maintaining proper adjustment at all times, these twins avoid excessive wear on the entire running gear and motion work of the locomotive.

They materially improve the riding qualities of the engine and save many times their cost in maintenance expense.

Franklin repair parts use jigs and fixtures that insure interchangeability, long life and dependability of service. Genuine Franklin parts are a guarantee of maximum trouble-free service.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

his home in that city on February 16. Mr. Ryan was born 61 years ago at Sterling, Ill., and had been with the company for 32 years.

HOWARD R. GASS, vice-president and a director of the St. Louis Car Company, St. Louis, Mo., died of a heart attack on February 13 on his farm at Cottleville, Mo., at the age of 52 years. Mr. Gass had been associated with the company for 16 years.

B. N. LAW, railroad sales manager (Central division), of the Air Reduction Sales Company, with headquarters at Chicago, died at his home in that city suddenly on February 1. Mr. Law, previous to his assignment to railroad sales work, had been manager of the Chicago district of the same company.

ELLSWORTH HARING, president of the Elhar Steel Company, died on February 18 in the Prospect Heights hospital, Brooklyn, N. Y., where he had been operated upon for appendicitis. Mr. Haring was born at Monroe, N. Y., 60 years ago, and for many years was in the steel business. He was a regular attendant during a long period of time at the June Mechanical conventions at Atlantic City, N. J., and was also active in the affairs of the New York Railroad Club, having served at one time as chairman of its reception committee.

FRANCIS E. SYMONS, president of the Ralston Steel Car Company, Columbus, Ohio, died at his home in that city on January 23 at the age of 62. Mr. Symons was born at Newark, Ohio, and had been associated with the Ralston Steel Car Company for the past 28 years, having served as its president since 1921. He was also president of the Ralston Scales Corporation. Mr. Symons, who had previously been in railway service with the Baltimore & Ohio and the Erie, was, in 1907, elected vice-president of the Ralston Sales Company and the Ralston Steel Car Company. He made his headquarters at New York until 1918, three years prior to his election to the Ralston presidency, when he moved to Columbus. He was a director of the American Railway Car Institute, also a member of the code authority for the railway car building industry.

Francis E. Symons

Personal Mention

General

WALTER M. ENGLISH, acting superintendent of motive power of the Chicago, Indianapolis & Louisville, has been appointed superintendent of motive power, with headquarters as before at Lafayette, Ind. Mr. English was born on February 25, 1891, at Danville, Ill., and was educated at Purdue University, from which he obtained the degree of Bachelor of Science in Mechanical Engineering in 1913, and the degree of Mechanical Engineer in 1917. He entered the service of the Monon on September 10, 1914, as a special apprentice at Lafayette, being promoted to the position of mechanical inspector on March 1, 1916. On October 1 of the following year Mr. English became master mechanic of the Northern division, with headquarters at Lafayette. On July 15, 1933, he was appointed acting superintendent of motive power.

Walter M. English

Master Mechanics and Road Foremen

W. L. TROUT has been appointed general master mechanic of the Minneapolis & St. Louis with headquarters at Minneapolis, Minn. The positions of superintendent of motive power and rolling stock and of master mechanic, which have been held by H. W. Johnson and L. M. Chapman, respectively, have been abolished.

Obituary

CHARLES H. VAN WHY, former general locomotive inspector of the Central of New Jersey, died on February 13 at his home in Roselle, N. J., at 78 years of age. Mr. Van Why retired in 1928.

THOMAS R. STEWART, superintendent of Mount Clare shops of the Baltimore & Ohio, with headquarters at Baltimore, Md., died on February 19 at Bon Secours Hospital. Mr. Stewart was 72 years old.

C. H. DYSON, fuel agent of the Baltimore & Ohio, with headquarters at Baltimore, Md., died at Miami, Fla., on February 15. Mr. Dyson was president of the International Railway Fuel Association from 1930 to 1933.

GEORGE S. WRIGHT, who retired in 1931 as general storekeeper of the Elgin, Joliet & Eastern, died on February 2.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

CORKBOARD.—Corinco isolation corkboard for the control of noise and vibration is described in a bulletin issued by the Cork Insulation Company, Inc., 155 East Forty-Fourth street, New York.

JOURNAL JACKS.—The construction features of standard and aluminum alloy journal jacks are shown in cross-section in Form No. 516 issued by the Duff-Norton Manufacturing Company, Pittsburgh, Pa.

AIR NOZZLES.—The new line of Lunkenheimer air nozzles, with renewable non-metallic disc, is described and illustrated in a four-page folder issued by the Lunkenheimer Co., Cincinnati, Ohio.

DIESEL ENGINES.—Bulletin S-500-B6d, a 16-page booklet issued by the Worthington Pump & Machinery Corporation. Harrison, N. J., contains much data of general interest on the subject of Diesel construction and its application to a wide range of services and industries. The essential details and features of a typical engine are shown in a sectional drawing.

No. 8-ET BRAKE EQUIPMENT.—The New York Air Brake Company, 420 Lexington avenue, New York, has issued descriptive catalog No. 2052 describing the new 8-ET locomotive brake equipment.

PNEUMATIC TOOLS.—The Chicago Pneumatic Tool Company, 6 East Forty-Fourth street, New York, has issued a bulletin descriptive of the Super Safety balancer for suspending, balancing and lifting portable tools or objects up to 200 lb. in weight. A second bulletin, No. 728, describes Type T horizontal, single-stage compressors.

SIGNAL VALVE REPAIRS.—The New York Air Brake Company, 420 Lexington avenue, New York, has issued two new instruction leaflets. The first, No. 2377, covers the repair shop test code for the New York Style BA and the Westinghouse signal valves furnished for many years. Causes and remedies for improper operation are also included. The second pamphlet, No. 2377-1, contains similar information for the new Type C signal valve.